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Office of Research and Development
Strategic Plan

ORD's mission:

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.

Office of Research and Development

Strategic Plan

US EPA Office of Research and Development

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Executive Summary

The Office of Research and Development (ORD) has taken the arrival of the millennium as an opportunity to reassess itself. Over the last two years, building on the U.S. Environmental Protection Agency's (EPA's) Strategic Plan and ORD's two previous strategic plans, we have developed a clear and strong strategic direction that will guide us through the next decade. This *Strategic Plan* reaffirms our commitment to providing the best quality science possible in support of a clean and safe environment and provides the roadmap for how we will achieve each of the five organizational goals that we believe collectively define our aspirations and purpose. It also describes how our research priorities align with and support EPA's Strategic Goals.

ORD's mission 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**. This mission commits ORD to conduct its research in a way that will have a direct and meaningful impact on EPA's decisions and programs. To determine how best to fulfill this mission in a world of new and increasingly complex environmental issues, we built upon our previously published 1996 Strategic Plan and its 1997 update by holding numerous discussions with: customers in the EPA programs and regions; stakeholders in the research and environmental protection communities including organizations at the federal, state, local, and tribal levels; and, most important of all, our staff. These discussions provided valuable insights into emerging trends and helped us to refine our goals, develop the actions under each goal, and create appropriate measures of success.

This *Plan* describes ORD's organizational goals and the actions we will take over the next decade to achieve these goals. In achieving these goals, we will ensure that our science continues to be of high quality, timely, relevant, and responsive. Our *Strategic Plan* does not alter our research priorities, which are the product of a careful and comprehensive Agency-wide planning process. Instead, it focuses on ORD as an organization and serves as the roadmap for how we will work together and organize our activities over the next 10 years to more efficiently and effectively support EPA's mission. Rather than concentrating on ***what*** research we will do, it sets direction for ***how*** we will accomplish our mission.

ORD has established five strategic organizational goals to meet the challenges of the future. First and foremost, ORD seeks to support EPA's mission by providing high-quality, relevant, responsive, and timely science (Goal 1). This means that ORD must ensure that a balanced program of ***problem-driven*** and ***core research*** is always guided by the principles of "science for a purpose" and clearly serves the expressed needs of our internal customers in the program and regional offices.

To accomplish Goal 1, ORD must be a high-performing organization (Goal 2). We are committed to the growth and development of our staff and the continuous improvement in the efficiency and effectiveness of our organization and infrastructure.

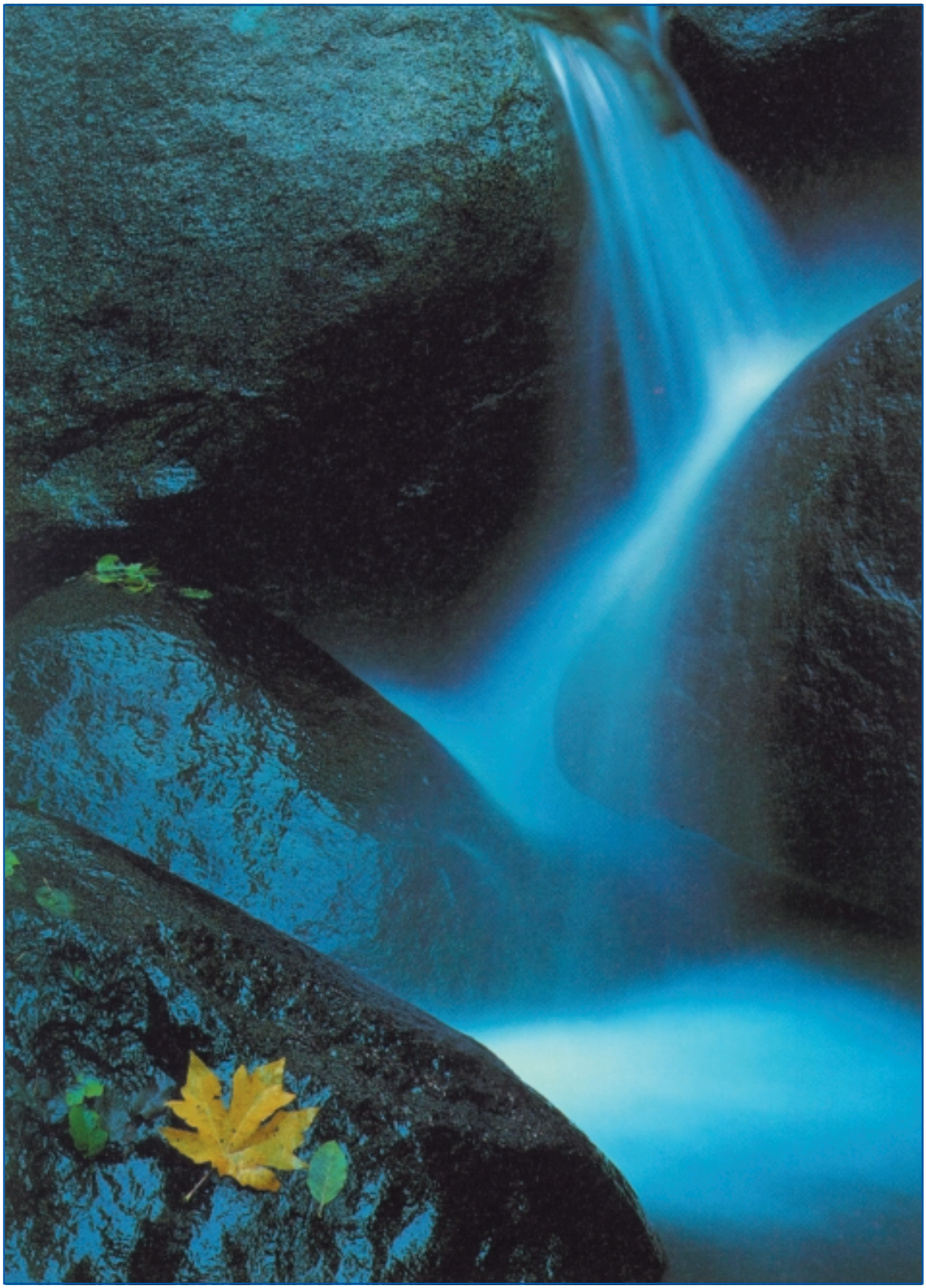
For ORD to support EPA's mission effectively, our staff and our organization must exercise leadership in the broader scientific community (Goal 3). We will do this by participating in scientific meetings, serving on professional committees, contributing to scientific debate, and playing a leading role in creating a national environmental research agenda. These activities will keep us abreast of cutting-edge science and provide us with the scientific foundation necessary for effective environmental protection.

Integration (Goal 4) addresses ORD's unique role—our ability to synthesize the broadest range of cutting-edge science and engineering into a comprehensive set of insights and an understanding of the increasingly complex environmental problems that we face. It means integrating across disciplines, scales of time, media, and location to provide decision-makers with a comprehensive picture of the risks posed and the opportunities for preventing or mitigating those risks.

Anticipating future environmental issues (Goal 5) represents our role in long-term environmental stewardship. To meet this Goal, we must foresee and react to environmental challenges before adverse effects materialize or are widely noticed. This foresight will allow us more time to perform the necessary research and put into place the appropriate response before costs become prohibitive or effects irreversible.

ORD's *Strategic Plan* does not exist in a vacuum. It is bounded by and connected to other planning activities in ORD and EPA. Within the planning, budgeting, and accountability framework established by EPA's Strategic Plan, ORD develops its research priorities through an extensive annual planning process that includes input from our customers in EPA's program and regional offices. The result is a portfolio of research spanning the major elements of EPA's work and is reflected in ORD's Annual Performance Plan and budget justification. Recently, ORD initiated a "multi-year" planning process as a way to link its Annual Plan both to the longer-range objectives contained in the EPA Strategic Plan and to the commitments made under the *Government Performance and Results Act of 1993* (GPRA). Our *Plan* also discusses our risk-based planning approach and demonstrates the linkage of our research program to Agency Goals.

ORD has developed this *Strategic Plan* as a path between our past and our future. The scientific priorities identified in our two previous Strategic Plans and the current EPA Strategic Plan still hold true. Over the next decade, we will carefully, consistently, and diligently implement this *Strategic Plan*, action by action, throughout ORD. An extensive effort is already underway to prepare a detailed implementation plan describing our priorities for action, available resources, timelines, and methods for ensuring accountability. We will track our results, measure our progress, and make mid-course adjustments as necessary to reflect changing conditions and new opportunities as they arise. We will report our results to our customers and stakeholders regularly and learn from other organizations as we go. In so doing, we will hold ourselves accountable to each other, and to our customers, stakeholders, and each other for achieving our goals and future success.



The Context of the Strategic Plan

The Environmental Protection Agency's (EPA's) mission is to protect human health and to safeguard the natural environment—air, water, and land—upon which life depends. Science supports this mission by providing EPA and the American people with the knowledge needed to make informed decisions about risks to human health and the environment, and with opportunities to prevent or mitigate these risks. Within EPA, the Office of Research and Development provides leadership in science and engineering, and conducts most of the Agency's research and development. Through research and technical assistance, ORD provides the scientific foundation for EPA's regulatory programs and decisions, assesses the state of the environment, identifies new issues of potential concern, and provides information and tools to support risk-based decisions.

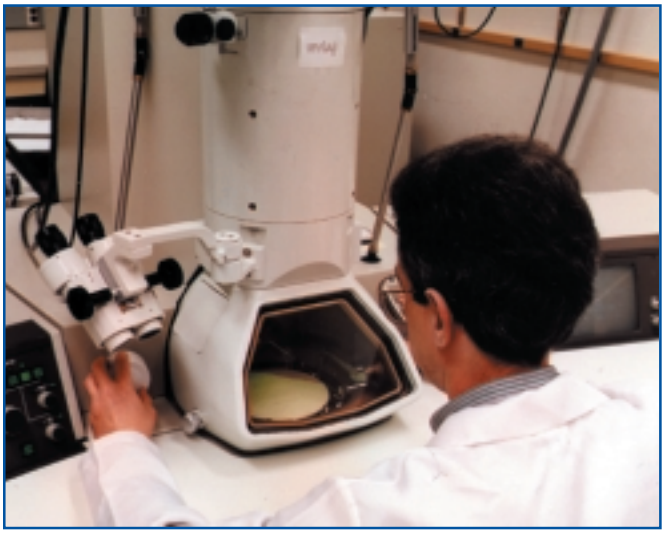
The Purpose of This Plan

ORD's *Strategic Plan* is the latest stage in a multi-year effort to improve ORD's organizational effectiveness and research program. This *Plan* describes ORD's organizational goals and the actions we will take over the next decade to achieve these goals. In so doing, we will ensure that our science continues to be of high quality, timely, relevant, and responsive.

This *Plan* does not alter our research priorities, which are the product of a careful and comprehensive Agency-wide planning process. Instead, this *Plan* focuses on ORD as an organization and serves as the roadmap for how we will work together and organize our activities over the next 10 years to more efficiently and effectively support EPA's mission. Rather than concentrating on ***what*** research we will do, this *Plan* sets direction for ***how*** we will accomplish our mission.

Background

ORD's *Strategic Plan* builds on the evolution in ORD's organizational structure and research planning that began in the mid-1990s in response to a number of external



reviews of EPA's research programs, as well as a Congressional directive that EPA examine its overall laboratory structure. In 1995, as a result of these reviews and a strong internal desire to strengthen and better focus our research program, ORD implemented the most sweeping reorganization in its history.

The scientific rationale for the new structure was the scientific risk assessment/risk management paradigm—a sequenced set of specific interrelated analytic steps that are employed in assessing environmental risks and making decisions on how to reduce those risks. Simply stated, these steps involve a process to: 1) characterize the nature and magnitude of human health or environmental effects; 2) determine the magnitude and routes of exposure to causative contaminants or stressors; 3) combine these into an assessment of risk; and, 4) evaluate sources and implement strategies or technologies to reduce risk. Using this organizing principle, ORD combined 12 existing laboratories into three National Laboratories (covering environmental effects, exposure, and risk management) and a National Center for Environmental Assessment which mirror the four components of the paradigm.

ORD Is Composed of Three Laboratories, Two Centers, and Two Offices

These are:

- National Health and Environmental Effects Research Laboratory
- National Exposure Research Laboratory
- National Risk Management Research Laboratory
- National Center for Environmental Assessment
- National Center for Environmental Research
- Office of Science Policy
- Office of Resources Management and Administration

At the same time, ORD created a National Center for Environmental Research to manage an enlarged and strengthened competitive extramural grants and fellowship program. Two Headquarter Offices were formed to provide support and oversight, the Office of Science Policy and the Office of Resources Management and Administration (see Appendix A for the ORD Organizational Chart).

Following the reorganization, ORD published a Strategic Plan in May 1996. The 1996 Plan proposed evaluating research and development priorities based on comparative risk—or, stated in different terms, on reducing uncertainty about the potentially greatest risks. The 1996 Plan, which was updated in 1997, outlined ORD's high-priority research topics and included their strategic focus, key elements, anticipated research products, and intended uses. The 1996 Plan and its 1997 update also set in motion an effort to develop a series of externally peer-reviewed research strategies and plans describing the rationale, strategic direction, and key components of ORD's research program.

In 1997, EPA also implemented the *Government Performance and Results Act of 1993* (GPRA) which resulted in additional changes for ORD. The Agency produced a comprehensive Strategic Plan and restructured its budget around 10 Agency-wide Goals. The Agency also prepared its first Annual Performance Plan and Congressional Justification for 1999 in accordance with the new GPRA structure. This Annual Plan included Performance Goals and Measures that would be accomplished with the proposed budget. It is this process that ORD now uses to plan its research and development program and is discussed in further detail later in this document.

Concurrently, ORD has taken the lead in looking broadly at EPA science by drafting the January 2000 *Strategic Framework for EPA Science.* The Framework contains three unifying principles for EPA science: use of the Agency-wide science inventory; effective planning ("doing the right science"); and sound science ("doing the science right"). EPA, through its Science Policy Council, has adopted and is implementing these principles in cross-agency science activities sponsored by the Council.

The Future We Seek

ORD has developed this *Strategic Plan* as a path between our past and our future. The scientific priorities identified in our two previous strategic plans and the current EPA Strategic Plan still hold true. We are on track in providing high-quality, timely, relevant, and responsive scientific research and technical assistance to support EPA's mission to protect human health and the environment.

At the same time, we recognize that we face new challenges that will alter how we plan, conduct, and communicate science, how we view and anticipate environmental problems, and how we manage our organization. It is clear that the environmental issues that we will address in the next decade are increasingly complex, subtle, international, and interrelated. Similarly, the solutions required to address these issues will place a growing premium on sound science and risk-based decision-making.

Moreover, we face rising expectations from our partners, stakeholders, and the American people for more scientific information on: environmental and public health risks; how these risks may differ for different groups or different locations; and how they can be reduced in a cost-effective manner.

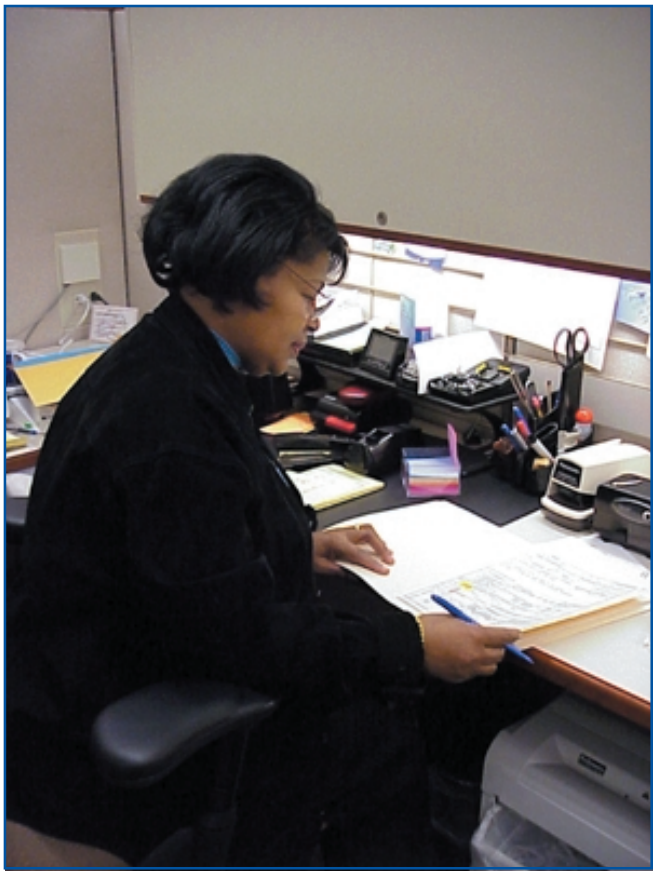
We recognize and embrace these challenges as opportunities to demonstrate the excellence of our work and the strength of our commitment to a safe and clean environment. This *Strategic Plan* will guide our efforts.

How This Plan Was Developed

The *Plan* focuses on five strategic organizational goals that were originally drafted by ORD's Executive Council. The ORD Executive Council is composed of the Assistant Administrator for Research and Development, the Deputy Assistant Administrators for Management and for Science, and the Directors of ORD's Laboratories, Centers, and Offices.

Meetings with the workforce were held throughout our locations to discuss the goals, what they meant, why they were important, and how we might achieve them. These meetings, and much of the other consultation with our workforce, were organized and coordinated by the Strategic Plan Workgroup, which included representatives throughout the organization.

In addition, many other staff members actively participated in developing this *Strategic Plan* through goal writing teams that were established for each of the five goals. Each team was responsible for using the diverse input collected to develop the specific objectives, actions, and measures of success under each goal. Whatever success derives from this *Strategic Plan* belongs to all those who participated in its development.



Emerging External Trends and Their Implications for ORD's Future

To complement and confirm the results of internal planning, we held discussions throughout 1999 with our internal EPA customers, other governmental organizations, and key external stakeholders from trade associations, professional societies, and public interest organizations. These discussions focused on gathering customer and stakeholder perspectives on the future of science and environmental protection over the next 10 to 20 years, and on related demands and expectations facing EPA. These meetings produced a broad consensus about several significant, persistent, and highly relevant trends. The details concerning our June 3, 1999, external stakeholder meeting can be found on the Internet at *http://www.epa.gov/ORD/SP.*

ORD's customers and stakeholders believe that the nature of environmental protection is changing in significant ways. One of their most important observations is that certain approaches to environmental protection—which produced environmental gains over the past 30 years—have begun to yield only marginal returns in the face of continued population growth and economic expansion. Using traditional regulation of large municipal and industrial sources of pollution and focusing on individual chemicals, pollutant classes, or a single medium can no longer, by themselves, be counted on to provide the level of environmental protection that the American people desire.

ORD's Customers and Stakeholders

ORD's ***customers*** are those who directly use ORD's research products and technical assistance to protect human health and safeguard the environment. ORD's primary customers are EPA's program and regional offices but also include state environmental agencies, tribal organizations, and other parts of the federal government.

ORD's ***stakeholders*** are those individuals or organizations with a specific interest in ORD's work and accomplishments. This larger set includes industry, trade associations, the academic research community, public interest groups, and in the broadest sense, the American people. Some stakeholders may also be customers.

Further, these traditional approaches, while still necessary, are not likely to effectively address new issues such as global climate change, loss of habitat and biodiversity, non-point source pollution, and risks associated with emerging technologies. In addition, rising public expectations call for finely tuned environmental solutions addressing the needs or special circumstances of specific populations (such as the elderly or children) and specific communities, water bodies, or airsheds.

As a consequence, while EPA's traditional media programs will continue to be the mainstays of the environmental protection system in the United States, new or different and more complex approaches will be required to realize significant environmental gains in the future. Examples of these approaches include market-based approaches, voluntary programs, greater information sharing to allow for informed risk-based decisions by individuals and corporations, and partnerships with others concerned with human health protection and environmental stewardship.

The following trends were identified by our customers and stakeholders as likely to have the greatest influence on ORD over the next 10 to 20 years:

- *New arrangements among EPA and individual citizens, states, tribes, industry, and other organizations* will be developed, driven by changing needs and expectations for more cooperative arrangements with industry and community-based decision-making.

- *Traditional single-medium problems and programs* will face new challenges because of continued population growth, economic expansion, and aging infrastructure.

- The complexity of emerging environmental issues will place a premium on *integrated, multimedia, multidisciplinary research* to allow for sound decision-making where difficult, subtle, and possibly uncertain trade-offs of risk and risk management are involved.

- *New technologies* (e.g., miniaturization, energy generation, transportation, remote sensing) offer great promise to ameliorate existing problems and provide better information about the state of the environment, but also may bring with them new risks that need to be assessed.

- An aging, more affluent, and better educated society will have *greater expectations for environmental quality,* including ecological restoration (to complement environmental protection), which will lead to greater demands for environmental information.

- The increasing availability of environmental information and tools for interpreting this information, especially over the Internet, will require *increased and improved risk communication.*

- There is a need to expand our understanding of environmental research so that *the findings of economics, sociology, psychology, and other social sciences can be incorporated into decision-making,* because environmental protection increasingly focuses on the decisions and behaviors of individuals as consumers, commuters, and property-owners.

The sum of these anticipated trends is a growing role for scientific information in the formulation, development, and implementation of public policy toward the environment, and consequently, a potentially growing role for ORD.

The perspectives of ORD's customers and stakeholders have offered us a look into the future and a basis for better understanding the challenges we face as we try to achieve our mission. Consideration of these trends and their implications for how we plan, conduct, and manage our research were influential in the development of the goals, objectives, and actions in the *Strategic Plan.* It should also be noted that, an implicit assumption for the development of the *Plan* was that public attitudes toward the environment and funding for environmental protection and research would remain fairly stable over the next decade.

ORD's Strategic Organizational Goals

ORD has established five strategic organizational goals to meet the challenges of the future. The goals are as follows:

- **Support the Agency's Mission**
- **Be a High-Performing Organization**
- **Be a Leader in the Environmental Research Community**
- **Integrate Environmental Science and Technology to Solve Environmental Problems**
- **Anticipate Future Environmental Issues**

Each goal contains several focused objectives, under which are specific actions. The actions represent the set of activities that ORD will implement in order to meet each objective and, taken together, achieve all of the goals. Individually, each goal represents an aspiration we seek to achieve. Collectively, our goals define the full range of ORD's role in shaping the future of environmental protection.

Figure 1: ORD's Strategic Goals

As Figure 1 shows, ORD's five goals are closely interrelated. **Supporting the Agency's mission (Goal 1)** is central to the other four goals and is the guiding focus for all ORD employees. While other agencies such as the National Science Foundation play a critical role in pursuing our fundamental understanding of nature and natural phenomena, ORD is committed to pursuing "science for a purpose," namely, protecting human health and the environment from the unintended consequences of humankind's use of the earth and its atmosphere. ORD is part of a regulatory Agency, and ORD's scientific products and expertise are critical to supporting agency decision-making. First and foremost, ORD must be a strong advocate for sound science across the Agency.

Being a high-performing organization (Goal 2) allows us to achieve our other strategic goals. In order to accomplish what we have set forth, our organization will encourage scientific leadership, integration, and anticipation in pursuit of our primary goal of supporting the Agency's mission. We will attract, retain, and develop a highly qualified and diverse workforce to meet the challenges we face. Policies and administrative processes will provide tools to promote risk-taking, integration, and anticipation of trends. The performance and promotion system will encourage and reward progress toward our strategic goals.

Science leadership (Goal 3) is a key component of our success. If we are to provide sound science for environmental decision-making, it must be recognized as leading edge. In addition, there is more mission-critical research than ORD scientists and engineers can perform, which means that we will leverage ORD's resources with the research expertise in academia, in other research institutes, and in state, federal, local, and tribal organizations that conduct environmental research. ORD will demonstrate and model environmental science leadership within EPA and in the broader scientific

community. This leadership will help us to integrate science, anticipate the future, and become a high-performing organization.

Integration across environmental science and technology (Goal 4) requires leadership and is critical to meeting the challenges of the future. EPA has long known that solutions addressing problems one at a time and one medium at a time are less efficient and, therefore, only partially effective. Integration across the risk paradigm (i.e., source-exposure-dose-effect-management) is a critical first step to achieving more effective solutions and meeting future challenges. Integration across environmental media (i.e., solutions that solve a problem in one medium have additional benefits in another, rather than unintended negative consequences) is needed to recognize trade-offs.

Integration across disciplines, including the social sciences, is yet another step leading to the ultimate goal of solutions that integrate protection of human health with protection of ecosystems. Finally, integration of extramural research conducted through our Science to Achieve Results (STAR) grants program with our intramural research efforts greatly expands our scientific effectiveness and impact.

Anticipating future environmental trends and issues (Goal 5) can help ORD maintain a leading-edge view of scientific needs for preventing or ameliorating potential environmental problems. Environmental "futures" thinking will lead to better articulation of new directions and strategic planning of research—before problems emerge and lead to environmental damage and degradation. Through futures thinking, ORD will support more informed EPA decision-making, shape the national environmental research agenda, and reinforce ORD's leadership position in the scientific community.

Goal 1 Support the Agency's Mission

Goal Statement

ORD will support the Agency's Strategic Goals through collaborative relationships with its program and regional offices by providing high-quality, relevant, responsive, and timely scientific information and research results.

What This Goal Means

Science is the foundation of all of EPA's work. ORD's role is to deliver problem-driven and core research, scientific advice, and technical support that provide a solid scientific basis for EPA policy and program decisions. Our research and scientific support activities must clearly contribute to the Agency's Strategic Goals. Although ORD's research may benefit many customers, our success will be primarily measured by the extent to which our research helps EPA accomplish its mission, both now and in the future.

In achieving our mission ORD is committed to following a balanced program of ***problem-driven*** and ***core research***–with the additional condition that research must always be necessary for, not just relevant to, environmental protection and restoration. ***Problem-driven research*** directly addresses a specific, identified need in order to support a regulatory action or program activity. This research may be needed to review a criterion, meet a legislative mandate, or provide technical support to a program or regional office, such as developing methods for detecting and removing microbial contaminants from drinking water.

We also recognize the need for a strong body of ***core research*** focusing on elucidating key physical, chemical, biological, geological, sociological, and economic processes that are important in understanding and predicting the effects of human activities on human health and the environment. This type of research provides the scientific basis for understanding a wide range of environmental issues and problems. It includes, for example, research on biological indicators of ecosystem health or development of improved methodologies for assessing cumulative exposure to contaminants.

Today's core research program will provide the foundation for our problem-driven research in future years, and today's problem-driven research helps to shape our future core research portfolio. We conduct both problem-driven and core research, focusing on the common element of facilitating the work of the rest of EPA.

An extensive discussion of problem-driven and core research can be found in *Building a Foundation for Sound Environmental Decisions, Committee on Research Opportunities and Priorities for EPA*, National Research Council, National Academy of Sciences, 1997.

As a result, ORD's research must be results-oriented and customer focused. Specifically, our research needs to be:

- Rigorous, objective, and thorough;
- Structured and conducted to provide complete and integrated information relevant to decision-making;
- Focused on the needs of our customers; and
- Provided in a timely and useful manner.

Why This Goal Is Important for ORD

EPA is a mission-oriented agency; its work is focused on the specific goals and objectives described in EPA's Strategic Plan. ORD provides the scientific support that enables the Agency to meet those goals and objectives. EPA depends on ORD; its scientific reputation is built on our work. As a result, our research must respond to and anticipate the Agency's needs. Science that is not supportive of EPA's mission may be important, but it need not, and should not, be done by ORD. We must keep ourselves focused on helping EPA program and regional offices to fulfill their mandates and achieve their goals to address the nation's most important environmental and human health risks through research and development, assessment methods, and management options.

Because EPA's responsibilities are broad, important, and heavily informed by science, ORD must maintain a robust and wide-ranging research agenda. The challenge for us is to ensure that this research is organized, conducted, and delivered to the Agency in such a way that it makes a positive difference in the lives of the American people.

Goal 1 Objectives and Actions

1.1 Maintain a balanced program of problem-driven and core research.

1.1.1 – Develop multi-year plans that address key outcomes needed by the Agency and a logical sequence of work to achieve them.

1.1.2 – Communicate the value of core research outcomes and products to the program and regional offices to develop a common understanding of the link between this research and the Agency's long-term policy and decision-making needs.

1.1.3 – As part of the planning process, link research outcomes to current and emerging Agency needs.

1.1.4 – Continuously improve the research planning and coordination process to engage ORD's EPA partners, enhance transparency and efficiency of the process, and ensure that we are doing the right research.

1.1.5 – Clearly link the research funded by extramural grants to the Agency's Goals and GPRA framework.

1.2 Proactively lead EPA's effort to ensure that sound science is synthesized, integrated, and communicated in a form that supports effective environmental decision-making by EPA and its stakeholders.

1.2.1 – Promote more frequent and direct communication between ORD scientists and engineers, and programs, regions, and states to ensure that the science is properly interpreted and communicated for use in the regulatory process.

1.2.2 – Expand efforts to communicate the results of ORD's research inside and outside ORD (e.g., using State-of-the-Science reports; assessments and criteria documents; and sponsorship of national meetings, workshops, and symposia on key human health and ecological issues).

1.2.3 – Develop, maintain, and promote a searchable database of ORD research projects and results.

1.2.4 – Develop mechanisms to ensure that problem-driven research delivers a complete product that integrates the relevant research across ORD.

1.3 Provide technical assistance and regulatory support that meet the immediate needs of the program and regional offices.

1.3.1 – Include technical assistance and regulatory support needs in our multi-year research plans.

1.3.2 – Build an accurate, up-to-date, electronic and searchable ORD Technical Assistance Directory and routinely assess its impact and usage.

1.3.3 – Modify performance and promotion criteria to recognize the value of technical assistance and regulatory support to EPA's mission.

1.3.4 – Routinely interact with both the Regional and Tribal Science Councils to ensure the relevance and timeliness of ORD support.

1.4 Routinely obtain advice and feedback on our performance from our customers.

1.4.1 – Develop surveys and other tools to obtain and evaluate customer feedback.

1.4.2 – Incorporate customer feedback into our research planning process.

1.4.3 – Assess research productivity and performance and evaluate accomplishments through EPA's Science Advisory Board (SAB), ORD's Board of Scientific Counselors (BOSC), and other external peer review panels, and by benchmarking against other research institutions.

Measures of Success

Consistent with the recognition that our work is and should be focused on EPA's mission, protecting human health and safeguarding the environment are the ultimate measures of our success. It should be noted that a full set of Annual Performance Goals and Measures for our research can be found in EPA's Annual Performance Plan, as required by GPRA. To further evaluate this Goal, ORD will measure the feedback received from program and regional partners, the scientific community, Congress, and the public. Customer satisfaction surveys will determine how well the value and results of our research are communicated and how high our satisfaction is with the level of customer involvement in research planning. In addition, reports from the SAB, BOSC, and others will be used to assess ORD performance.

Other measures of success include the following:

- Citations or references in regulatory decision-making documents that reflect ORD's advice and research in formulating final decisions;
- EPA regulatory, enforcement, and other actions that are not delayed or rejected because of a lack of scientific and engineering rigor to support them;
- Peer reviews verifying that major uncertainties across the risk paradigm impeding environmental protection have been addressed; and
- Customer Satisfaction Surveys indicate that our research results are valued and responsive to their needs.

Goal 2 Be a High-Performing Organization

Goal Statement

ORD will be a high-performing organization in which employees communicate openly, serve customers, and work collaboratively to make ORD more effective and efficient.

What This Goal Means

Excellence in scientific and engineering research requires a strong, supportive organizational foundation. We are committed to the growth and development of our staff and the continuous improvement in the efficiency and effectiveness of our organization and infrastructure. Under this Goal, ORD will continue to provide leadership and devote resources to develop and foster our workforce, model effective management, and create a supportive work environment that promotes creativity, innovation, teamwork, and productivity. In short, we will recruit and retain the best possible people and provide them with the infrastructure, resources, and rewards for conducting results-oriented, customer-focused research in support of ORD's and EPA's missions. Becoming a high-performing organization will mean developing and sustaining the following:

- *A stimulating research environment* that attracts, holds, and values the best, brightest, and most energetic workforce in science, engineering, management, and administration and also encourages their creativity, innovation, and productivity;

- *Career opportunities* for staff to contribute to ORD's success, develop professionally, interact with colleagues, and achieve recognition;

- *Recognition and rewards* for achieving results, serving customers, and supporting each other;

- *Open, clear, and concise communication* that builds trust;

- *Efficiently managed and administered operations* that provide the resources and infrastructure for an effective research and development program;

- *Organizational flexibility* that balances the changing needs of the environmental agenda with the need for a stable research environment and ensures that administrative requirements are met with integrity while contributing to an atmosphere of trust;

- *A diverse workforce* whose varied backgrounds and perspectives are utilized and whose individual contributions are respected and valued; and

- *Clean, healthy, and safe facilities* that support and enhance the quality of ORD's science and engineering.

Why This Goal Is Important for ORD

Investing in our workforce and improving our organizational processes are key components of our success. The single most important factor is the talent and effort of our staff. None of our strategic goals can be realized without a highly qualified, diverse, and capable workforce. The discoveries and accomplishments we seek will spring from the efforts of a staff who are motivated in their work and provided with the support and recognition needed to help them do their best.

Motivating and supporting our workforce requires a culture that inspires respect, honesty, and trust and that rewards leadership, innovation, teamwork, and risk-taking. It also requires efficient management and administrative processes. All of these elements add up to

developing an organization where workforce policies, management and administrative processes, internal structure, and corporate culture are aligned to meet our strategic goals. Fostering this high-performing organization will directly contribute to achieving our other strategic goals by providing the workforce with tools and incentives to:

- Improve product delivery and customer service;
- Highlight our scientific excellence and leadership;
- Better integrate our work; and
- Better anticipate risks and issues.

Goal 2 Objectives and Actions

2.1 Recruit, retain, and develop a highly qualified and diverse workforce.

2.1.1 – Conduct an ORD workforce planning analysis to ensure staff competencies/skills mix to fulfill our mission.

2.1.2 – Develop and implement recruitment strategies to attract a highly qualified and diverse workforce.

2.1.3 – Institute an effective career development program for all employees, which includes a range of opportunities (e.g., rotations, training, Intergovernmental Personnel Act assignments, individual development plans, exchange programs with universities).

2.1.4 – Create and implement a consistent, ongoing approach to assess what attracts people to work at ORD and why they stay or leave.

2.1.5 – Modify promotion criteria to reflect ORD's mission and goals and clearly communicate performance expectations to staff.

2.2 Create a culture that inspires respect, honesty, and trust.

2.2.1 – Identify elements of a trusting work environment and develop and implement a plan to improve workplace trust at all levels of the organization.

2.2.2 – Train and evaluate all managers in communication skills, particularly on providing feedback and recognition to employees.

2.2.3 – Increase direct communication between managers and staff (e.g., open-door practices, skip-level meetings, informative e-mails).

2.2.4 – Develop and implement an internal communication improvement strategy.

2.2.5 – Institute a feedback process (e.g., 360-degree evaluations) for all employees.

2.2.6 – Publish statistics on hiring, awards, training, developmental assignments, promotions, and travel.

2.3 Create a stimulating work environment that encourages and rewards leadership, creativity, innovation, teamwork, and risk-taking.

2.3.1 – Provide opportunities for staff to share leadership responsibilities.

2.3.2 – Design and implement a leadership development training program.

2.3.3 – Institute a peer-nominated award that recognizes an employee who exemplifies leadership.

2.3.4 – Increase recognition of and actively publicize awards and employee accomplishments, including team accomplishments.

2.3.5 – Identify and eliminate or reduce barriers to innovation and risk-taking.

2.3.6 – Expand opportunities for use of multidisciplinary teams.

2.4 Align our management and administrative processes and tools to help staff achieve our mission.

2.4.1 – Use quality management techniques to analyze and streamline administrative procedures and processes.

2.4.2 – Develop an orientation program that outlines roles, responsibilities, processes, and procedures.

2.4.3 – Align the reward, recognition, and promotion processes/criteria with strategic organizational goals and directions.

2.4.4 – Maintain support for technicians, infrastructure, and equipment.

2.4.5 – Develop and maintain a multifaceted, effective communication system that permits the efficient flow of accurate information into, within, and outside of ORD.

2.4.6 – Develop mechanisms to identify and disseminate best practices throughout ORD.

2.4.7 – Benchmark other high-performing organizations to identify and implement best practices.

2.4.8 – Invest in state-of-the-art information technology that can significantly streamline internal processes, promote information sharing and collaboration within ORD and with outside organizations, and facilitate ORD's technical assistance and risk communication activities.

Measures of Success

The principal assessment of how well we are achieving this Goal will be quantitative and qualitative measures of human resource performance, employee satisfaction on organizational assessments, and measures of administrative efficiency. In addition, a high-performing workforce will be measured by the amount, quality, and impact of the science produced, as found in performance measures for Goals 1, 3, 4, and 5.

Specific measures for this Goal include the following:

- Objective human resources data on acceptance rates, turnover, exit interviews, percentages of operating budget spent on recruitment, diverse employee backgrounds, and career development and training;
- Organizational climate survey data on employee satisfaction with career development and training, communication, levels of trust, and rewards and incentives;
- Administrative efficiency measures such as ratio of scientists to administrative staff, average cost per procurement, and average time for document approval;
- Evaluation of the 360-degree feedback process on whether the feedback is valued, provided openly and honestly, and acted upon; and
- Demonstrated payback from information technology investments.

Goal 3 Be a Leader in the Environmental Research Community

Goal Statement

ORD will enhance its role as a national leader in the science and engineering research that underpins protection of human health and the environment, both by conducting and sponsoring mission-critical research and by playing a pivotal role in the development of a national environmental research agenda.

What This Goal Means

ORD's science leadership involves playing a key role in:

- Defining and developing a national environmental research agenda;
- Upholding the highest standard of independence, objectivity, and excellence in research;
- Being viewed as a source of expertise and knowledge by the scientific community and the American public;
- Communicating the value and results of scientific work; and
- Being a prominent participant in scientific and professional organization activities.

Leadership is not the same as recognition, and it is not limited to the individual. While ORD seeks to be recognized for the excellence of its work and the expertise and accomplishments of its staff, we also intend to lead by helping to coordinate the research direction and priorities of other organizations and by being a resource for communicating complex issues of science and risk to the American public.

In this context, ORD's science leadership will have several important dimensions. First, we will ensure that

all of our research is: focused on issues of importance to the Agency; provided in a timely, understandable, and useful format; and used in a rigorous and credible fashion. We will maintain our unwavering commitment to sound science—science that is independent, objective, and carefully peer-reviewed.

Second, we will involve others in achieving our research mission. ORD has only about 5 percent of the federal environmental research budget in the United States. As a result, we seek to exert a beneficial influence on the direction of environmental research conducted elsewhere in the federal government by cooperatively developing a national environmental research agenda.

Finally, we must exhibit leadership in a community-wide sense. This involves helping to define the national agenda through attracting and supporting the next generation of scientists early in their professional careers, being the prime source for reliable environmental data and methods, sponsoring meetings and workshops, and partnering with universities and other research organizations to leverage our skills and resources.

Cultivating and sustaining science leadership translates into exhibiting leadership at all organizational levels. Our scientists and engineers will be widely acknowledged as leaders in their respective research areas. Our managers and supervisors will be champions for science and science quality and leaders within EPA and ORD to ensure that our research is focused and timely. Corporately, ORD will strive to play a critical role in all aspects of national research initiatives that provide the scientific basis for EPA's mission. In addition, we will be leaders in communicating our research results to all of our stakeholders outside of EPA.

Why This Goal Is Important for ORD

Solving the complex environmental problems of the new century will require substantial leadership to focus research on issues that pose the greatest environmental risks. It is particularly important for ORD to conduct, stimulate, and support critical environmental research that will lead to a significantly better understanding of environmental risks and development of effective and efficient solutions to environmental problems. Within EPA, ORD's leadership to uphold the highest standard of independence, objectivity, and excellence in research will contribute to sound decision-making and efficient programs, thereby enhancing the public's confidence in EPA and its mission. At the same time, ORD's leadership in communicating risk and scientific information to the American people will help them to make their own informed decisions about environmental issues at either a local or national level, as consumers, commuters, property owners, and citizens.

Beyond EPA, ORD has an important leadership role in catalyzing and coordinating the development of a national environmental research agenda. To fill this role, ORD must hold the trust, respect, and confidence of scientists and administrators in other federal agencies, universities, and external research organizations. This trust will arise from the quality of our work, and the active and prominent participation of our scientists in professional societies and associations. Such activities will further ORD's ties to the scientific community, provide professional development opportunities and recognition to staff, and support Goal 4 on integration by fostering collaboration across organizations, disciplines, and topics.

Goal 3 Objectives and Actions

3.1 Lead the development and definition of a national environmental research agenda for integrating and coordinating federally funded environmental research.

3.1.1 – Establish a cross-agency workgroup to engage and coordinate with stakeholders and evaluate long-term needs to be addressed in a national environmental research agenda.

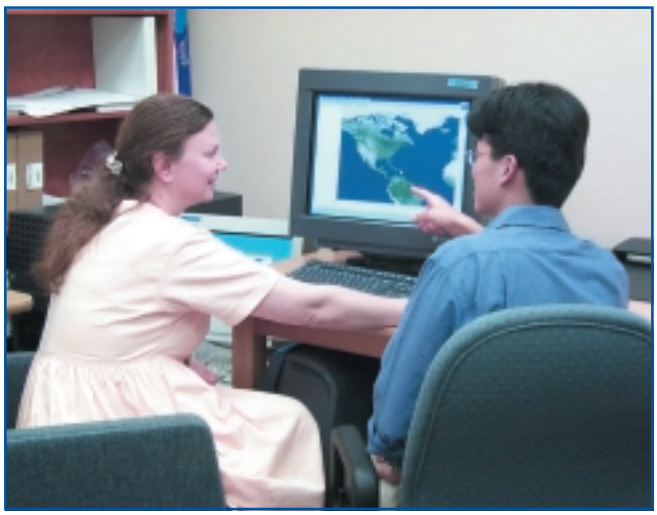
3.1.2 – Look for innovative ways to integrate federally funded environmental research across institutions.

3.1.3 – Coordinate with existing science policy institutions, such as the Office of Science and Technology Policy, the National Academy of Sciences, and other academic and scientific institutions.

3.2 Uphold the highest standard of independence, objectivity, and excellence.

3.2.1 – Improve and expand EPA's scientific peer review processes.

3.2.2 – Account for peer review of plans, results, and interpretation in the development of Lab/Center operating plans, as well as project completion schedules.



3.3 Be a widely used source of expertise and knowledge.

3.3.1 – Enhance the stature and visibility of ORD's science through an environment that fosters publication in high-quality journals and presentations at national and international scientific and technical meetings.

3.3.2 – Provide incentives for external collaborative research projects, programs, and workshops with researchers at universities and other research institutions.

3.3.3 – Provide incentives to encourage scientists to assume national leadership roles in professional organizations, such as scientific societies, editorial boards, advisory boards, and adjunct university appointments.

3.3.4 – Organize and sponsor technical workshops and symposia on emerging environmental problems and cutting-edge science.

3.4 Communicate the results and value of ORD research.

3.4.1 – Build a capacity to measure the effectiveness of ORD's major research programs and benchmark measures of effectiveness against other scientific organizations.

3.4.2 – Develop and implement improved mechanisms for synthesis and communication of research results and risk information to ORD's diverse audiences.

3.4.3 – Invest in information technology including an expansion of ORD's Web presence to share information and promote collaboration.

3.4.4 – Develop a standard format/logo/look for EPA/ORD products so that they are instantly recognizable to customers and stakeholders.

Measures of Success

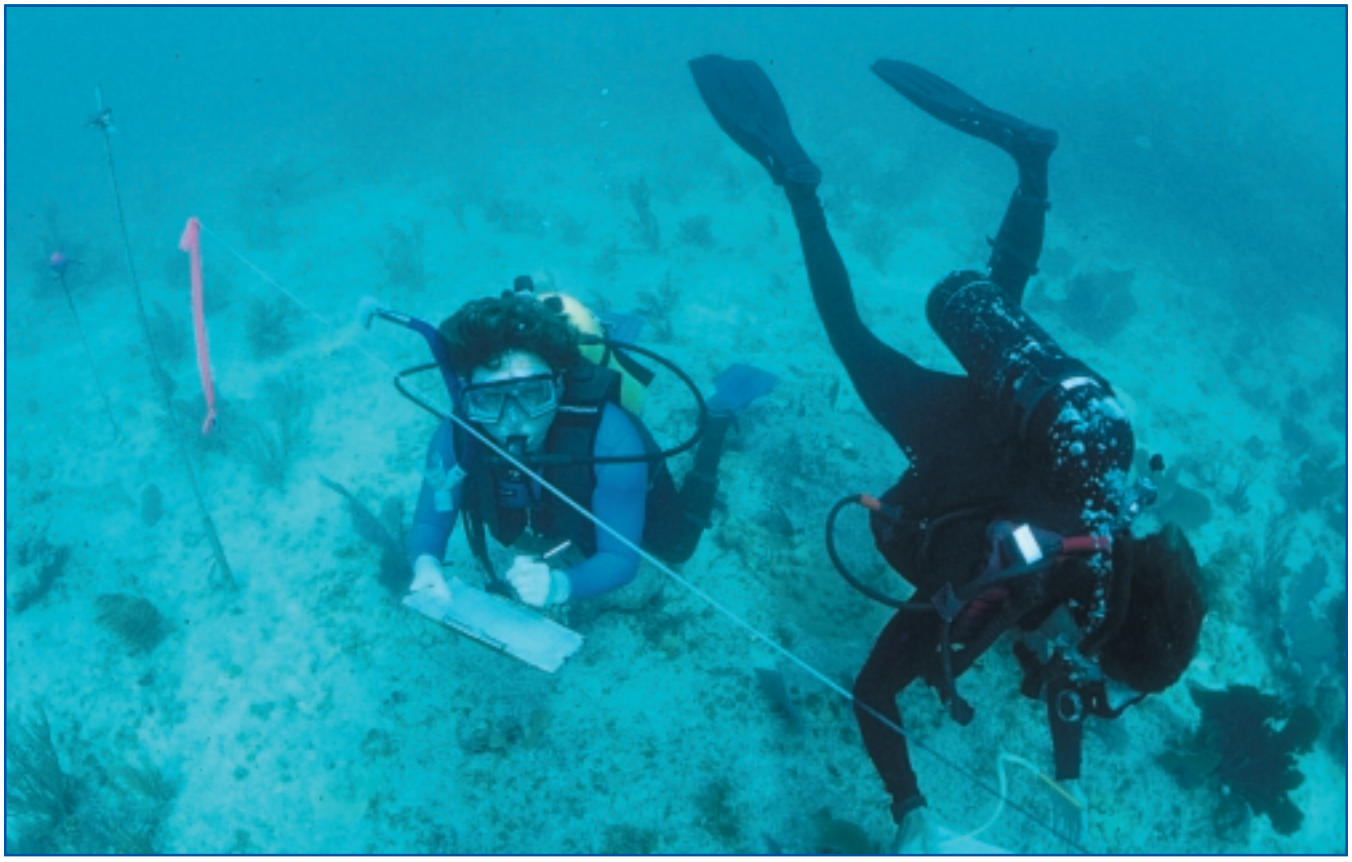
The measures of leadership are how positively we are viewed and how much our scientific contributions are valued, on an individual and organizational level, by our customers and stakeholders. This feedback must come from a variety of audiences—experts in specific disciplines, the broader scientific and environmental protection communities, Congress, and the American people.

Measures of leadership at the individual level include the following:

- External awards and recognition for ORD scientists;
- Publications in high-quality journals;
- Appointments to scientific societies, editorial boards, and adjunct university positions;
- Leadership roles at professional and scientific meetings, conferences, and symposia; and
- Invitations to ORD scientists to participate in conferences, workshops, symposia, and peer reviews.

Measures of leadership at the organizational level include the following:

- The creation and implementation of a national environmental research agenda and the extent to which it guides the planning and funding of environmental research;
- Citation rates as an indicator of quality and impact of publications;
- Critiques from independent organizations [e.g., National Research Council (NRC), SAB] regarding the independence, objectivity, and excellence of our research;
- Research programs involving multiple agencies or institutions;
- Requests from international organizations to visit EPA facilities or invitations to participate in their planning and review activities;
- Workshops and symposia conducted with researchers from other organizations;
- Cooperative Research and Development Act Agreements and Interagency Agreements;
- Requests for ORD research results and expertise from outside ORD; and
- Visits to the ORD Web site, including downloading of documents and reports.



Goal 4 Integrate Environmental Science and Technology to Solve Environmental Problems

Goal Statement

ORD will integrate its research across media, disciplines, and institutions to meet the challenges of complex environmental problems and to promote the discovery of holistic, efficient, and effective solutions.

What This Goal Means

Effectively solving environmental problems requires an integrated approach in which the necessary people and skills are brought together in a comprehensive program of research to answer the fundamental scientific questions. Furthermore, it means that the results of our research are assembled, presented, and communicated to Agency customers, key stakeholders, and the general public in a way that facilitates understanding and wise decisions.

Such integrated problem-solving is both a unique capability of, and opportunity for, ORD. Because of our broad mission related to both human health and ecology, close working relationships with the program and regional offices, established ties to universities and other research institutions, and a large, multidisciplinary research staff, we are qualified and positioned to integrate scientific research to understand and solve environmental problems.

To achieve this Goal, we will integrate research across the following:

- *Human and ecological health* by maximizing the degree to which relevant human health and ecological endpoints are addressed, including different health effects, levels of biological organization, and human populations;

- *The risk assessment/risk management paradigm* by ensuring that we evaluate the effectiveness of risk management alternatives based on net risk reduction, not merely pollutant reduction. We will set our risk characterization and assessment research priorities while recognizing the inherent uncertainties in risk assessment and the potential effect these uncertainties may have on decisions to develop prevention or control options;

- *Institutions* by drawing expertise from the appropriate ORD Laboratories and Centers, EPA program and regional offices, other federal agencies, universities, and U.S. and international research organizations;

- *Disciplines* by involving staff from the biological, physical, natural, and social sciences and from engineering; and

- *Media* by recognizing that the conditions of air, water, land, and human health are interrelated and that addressing risks in the context of one medium may alter risks in another.

All levels of ORD will pursue integration. At the individual researcher level, integration will occur across disciplines through coordination, cooperation, and collaboration. At the laboratory or center level, integration will require providing resources and encouragement for work beyond that lab's or center's traditional focus. Our scientists will coordinate with grant project officers and recipients throughout the research process. At the highest levels of ORD, planning, budgeting, and research execution processes and authorities will support integrated projects.

Why This Goal Is Important for ORD

In the past, the problems on which EPA focused, and sometimes the solutions as well, involved a scientific approach that was rather straightforward compared to the challenges that EPA is addressing now. Today's environmental problems are more complex, their causes less obvious, and their solutions more expensive and/or less certain. Addressing risks associated with a single environmental issue or problem often creates or alters risks elsewhere. Issues such as global climate change, ecological implications of emerging technologies, persistent bioaccumulative toxics, endocrine disrupting chemicals (EDCs), and habitat and biodiversity loss are inherently complex. They involve complicated issues related to fate and transport, exposure, and effects, and the associated human and animal behavioral responses to these risks or effects. Environmental science and engineering also will play an even more important role in the Agency's efforts to harmonize existing regulations and programs under its results-based management approach.

Sound risk-based decisions and environmental stewardship require the integration of the full range of knowledge about an issue. Integration across all relevant dimensions is neither easy nor straightforward, and it requires a broad mix of skills and organizational capabilities, including those outside of ORD. As confirmed in discussions with our stakeholders, we are uniquely positioned to fulfill this role because of our broad expertise and capabilities and the importance of our research to EPA's decision-making process. In addition, our relationships with universities and other research institutions provide the opportunity for new and more far-reaching partnerships to foster integrated research.

The Goal of integrating environmental science and technology to solve environmental problems complements ORD's Goal 1 on supporting the Agency's mission and Goal 3 on leadership. Integration will reinforce a sense of common purpose both among our staff and with EPA programs and regions. Through our research and technology transfer activities, we will provide our customers with integrated packages that solve a problem, constitute a complete tool set, or resolve the status of an emerging issue. We will encourage other environmentally focused organizations to move toward more holistic and comprehensive approaches to assessing and managing risk.

Goal 4 Objectives and Actions

4.1 Use ORD's multi-year planning process to identify priority environmental problems to be addressed by integrated research programs.

4.1.1 – Use the multi-year plans to identify and take action on key environmental problems that require integrated planning and implementation of research.

4.1.2 – Initiate projects that organize, integrate, and synthesize data and theory from multiple disciplines and research institutions to support integrated solutions to complex environmental problems.

4.1.3 – Include cross-laboratory annual performance goals and measures that provide integrative solutions for ORD's GPRA commitments.

4.1.4 – Elevate the priority of cross-organizational research in the annual planning process.

4.2 Improve ORD's research management and communication processes to facilitate and support research that provides integrated solutions to environmental problems.

4.2.1 – Make ORD models and data sets broadly available to researchers across ORD, to program and regional offices, and to the external scientific community.

4.2.2 – Establish communication mechanisms (such as scientist-to-scientist meetings, open houses, or staff orientation programs) to ensure that all staff understand the environmental problems being addressed, the need and opportunities for integrated solutions, and the need for the expertise of others.

4.2.3 – Conduct cross-laboratory program reviews to hold managers (i.e., line managers, associate and assistant directors, program managers, and team leaders) accountable for accomplishing cross-laboratory research goals.

4.2.4 – Modify the award and promotions program to reward cross-disciplinary and cross-laboratory research.

4.2.5 – Identify ways to promote interaction between EPA scientists, grantees, and external research organizations by benchmarking best practices and performance metrics from other multidisciplinary, broadly focused research organizations.

4.3 Dedicate efforts to increase utilization of ORD developed science in the Agency's regulatory programs and by the environmental community at large.

4.3.1 – Actively participate in the Agency regulatory process to communicate ORD research results and ensure such results are considered in the decision-making process.

4.3.2 – Take steps to ensure that ORD scientists and engineers are informed of, and understand, regulatory program needs and requirements.

4.3.3 – Improve communication of ORD's core research program to facilitate better integration across EPA program and regional offices.

Measures of Success

The ultimate measure of success of this Goal is the usefulness of ORD's integrated science and engineering products to Agency decision-makers, key stakeholders, and the public. More interim measures concern the number and type of integrated research and technology transfer activities occurring within ORD, including the following:

- Satisfaction scores on ORD organizational assessment surveys on questions related to the extent to which staff and management
  - are aware of the part their research plays in providing integrated solutions to environmental problems,
  - believe this research is well coordinated and complementary, and
  - are working on, have volunteered to work on, or want to work on integrative projects;
- Percentage of ORD's operating budget and staff devoted to integrated projects;
- Percentage of papers and presentations with authors from multiple disciplines and multiple institutions (other ORD laboratories, other parts of EPA, other agencies, or other organizations);
- Number of ORD staff members leading integrated programs and projects;
- Satisfaction scores on surveys of environmental decision-makers (inside and outside of EPA) regarding the utility of ORD's integrated products; and
- Reviews, scores, and comments by the SAB, NRC committees, and other outside bodies on the value and quality of ORD's integrated scientific solutions to environmental problems.

Goal 5 Anticipate Future Environmental Issues

Goal Statement

ORD will evaluate opportunities for and, as appropriate, will conduct research to anticipate and assess future environmental stressors—whether human health or ecological—before their effects adversely impact people or the environment.

What This Goal Means

In 1995, EPA's SAB published a report, *Beyond the Horizon: Using Foresight to Protect the Environmental Future*. In this report, the Board stated that "by engaging in environmental foresight, the American people can better understand the full range of risks and opportunities—environmental and economic—possible in the future and then better define the actions needed today to reduce the risks and preserve the opportunities." The panel made several recommendations recognizing the importance of understanding and managing future risk, establishing early warning systems, and calling for an EPA-led national effort to anticipate and respond to environmental change.

Goal 5 is to foresee future environmental stressors and understand or reasonably predict their potential impacts so that EPA can take action to prevent or avoid these impacts rather than just respond to them. Under this Goal, we will undertake a systematic "foresight" effort focused on potential issues 10 to 20 years into the future. In contrast, our current research planning and budgeting processes focus on a time horizon of approximately three to eight years.

The "foresight" approach has two parts in which ORD, working with the broader scientific community, EPA programs, regions, futurists, stakeholders, and the public, will:

- Search for detectable early warning signals and extrapolate them into the future; and
- Identify new issues for which an early warning signal does not currently exist.

By building capacity in this area, we expect to identify and understand potential future risks to human health and the environment, recommend new directions for research and program management decisions, and identify innovative, cost-effective solutions and alternatives through an ongoing futures program.

Our futures effort will be realistic in scope and focused primarily on workshops and information gathering rather than actual lab and field research. The work will focus on carefully selected issues for which the outcome may be highly uncertain but the reward is potentially very large. While our activities will include direct and frequent interaction with experts throughout EPA, we also will draw heavily from the views and thoughts of those from other agencies and organizations. Our outputs will inform the research planning and prioritization process and are expected to shape not only our future research efforts and priorities but also those of EPA's program and regional offices, other agencies, and organizations concerned with environmental quality.

Why This Goal Is Important for ORD

The benefit of foresight is the promise of increased environmental protection at less cost. As noted by the SAB, greater commitment to futures research will provide the following advantages:

- More time to study an issue and determine the best approach to address it before its full effects are felt;
- The opportunity to avoid or significantly reduce the sickness, injury, or environmental damage associated with an issue; and
- Lower costs and less social disruption by addressing an issue before its effects are large and widespread.

A systematic futures program is highly complementary with Goal 1 in supporting the Agency's mission and Goal 3 on scientific leadership. New insights on potential stressors will give EPA additional time for research and evaluation to support decision-making. Our futures program will supply new knowledge to shape the national environmental research agenda, maintain the relevancy and focus of our core research, and reinforce our leadership in the scientific community.

Goal 5 Objectives and Actions

5.1 Develop an organizational capability for environmental foresight.

5.1.1 – Establish a futures coordinating group, consisting of representatives from ORD Laboratories, Centers, and Offices and interested program and regional offices, to guide futures activities.

5.1.2 – Designate a senior champion and provide dedicated support staff to coordinate activities, provide continuity, and directly engage appropriate expertise.

5.1.3 – Provide resources to procure expertise in foresight analysis and other disciplines beyond ORD's traditional areas of science, and from organizations beyond ORD's traditional stakeholders.

5.1.4 – Benchmark processes and performance metrics from other organizations recognized for their futures analysis.

5.2 Stimulate dialogue both inside and outside EPA on future environmental developments and their significance.

5.2.1 – Convene discussions and workshops with outside experts using the two-part foresight approach to search for early signals and identify new opportunities. These discussions will focus on methodology and tools for doing futures analysis such as processes for data collection, characterization of issues, criteria for promotion of future action or investigation, and communication of the key potential efforts.

5.2.2 – Routinely gather information and input from EPA program and regional offices, the external scientific research community, futurists, and other stakeholders, on their visions and observations of the future relevant to environmental protection.

5.3 Pilot futures analysis for a few key environmental issues.

5.3.1 – Develop and evaluate pilot projects to identify one to three emerging issues of future concern within a one-year time frame to demonstrate the concept and to evaluate effective approaches to this type of analysis.

5.3.2 – Evaluate pilot projects, brief the ORD Science Council on the results, and recommend actions for future activities to the Assistant Administrator for ORD.

Measures of Success

By its very nature, futures analysis resists rigorous, immediate evaluation of its effectiveness. Because the impacts of stressors identified by futures analysis are more distant, judging whether ORD identified the "right" issues will only be known in time—most likely 10 years or more. More immediately, we will measure our performance by our outputs and the impact of these outputs on the research and policy agenda of ORD, EPA, and other organizations concerned with human health protection and environmental quality. Measures of success include the following:

- Extent to which issues identified from futures analysis inspire innovative research focusing on cost-effective risk management, new critical knowledge, risk avoidance, and/or better risk communication;
- Extent to which issues identified from futures analysis are an impetus for national research inquiry and debate;
- Extent to which Agency leaders seek advice on future environmental developments and foresight from ORD's futures coordinating group;
- Extent to which future environmental considerations and developments are used in rulemaking and major Agency initiatives;
- Resources committed to research or regulatory programs focusing on issues identified through futures analysis;
- Requests for technical assistance on conducting futures analysis from outside organizations; and
- Explicit incorporation of futures analysis in the Agency's strategic planning process.

Setting Research Priorities

The goals, objectives, and actions contained in this *Strategic Plan* will improve, but not fundamentally change, ORD's research planning process which has been steadily evolving since ORD's reorganization in 1995. ORD's priority-setting process for research has several significant characteristics, most notably the following:

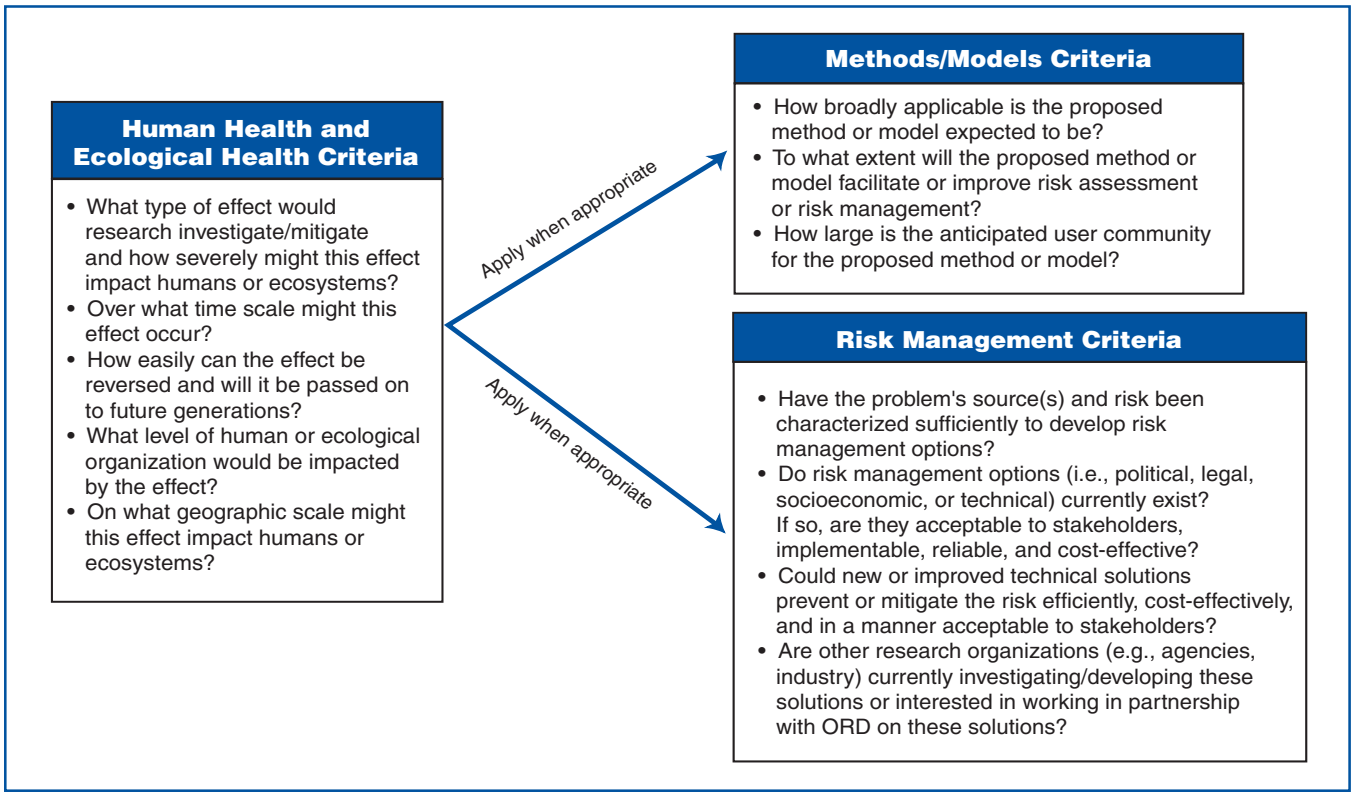
- We seek input from our customers throughout EPA as to the type of research and technical assistance of greatest importance to their programs, identifying in particular the research required to fulfill a legislative mandate, court order, or Agency GPRA commitment.

- We seek input from our staff as to the state-of-the-science and where the opportunities are for reducing uncertainty in our understanding of important environmental issues.

- For our preliminary ranking decisions, we examine research activities in terms of their scientific feasibility, resource constraints, compatibility with existing expertise, and our ability to make a contribution relative to other research institutions who may be doing work in the area.

In addition, we keep in mind a sense of human health, ecological health, and risk management criteria that we use to evaluate proposed research activities according to their potential to support effective risk reduction. The general criteria used in making these risk-based decisions are shown in Figure 2.

Figure 2: ORD's Criteria for Risk-Based Prioritization



The result of this comparative risk ranking is a broad portfolio of research spanning the full range of EPA's work. This process creates an appropriate balance between problem-driven and core research and aligns ORD's work in support of eight of EPA's 10 Strategic Goals. The research portfolio is then used to develop ORD's budget request and is reflected in the Annual Performance Plan, which EPA must submit under GPRA. In this way, all of ORD's work is aligned with, and linked to, specific annual performance goals that derive from EPA's Strategic Plan (see Table 1 on Page 28 for EPA's Strategic Goals).

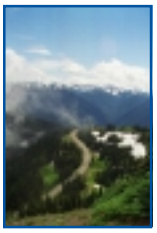
Recently, ORD initiated a multi-year planning process as a way to link the Annual Performance Plan to the longer range objectives contained in the EPA Strategic Plan. Issue-specific plans are under development that will identify Annual Performance Goals and Measures for ORD's research program over a 5- to 10-year period. These plans will enable ORD both to better design its research program in support of EPA's Strategic Goals and to simplify the annual planning effort. Table 2 on Page 29 shows the linkage between ORD multi-year plans and EPA's Strategic Goals.

In addition to these planning efforts, ORD also develops strategies and plans for specific research areas. These plans are developed on an as-needed basis for large, complex research programs that require coordination and planning across the risk paradigm, several different media or organizations [e.g., Children's Research, Particulate Matter, Endocrine Disrupting Chemicals (EDCs)]. These strategies and plans identify the most important scientific questions to be addressed, what research is needed to answer these questions, and how ORD can uniquely contribute. In addition to input from within the Agency, these strategies and plans also receive independent, external peer review. All of ORD's research strategies and plans are available on the Internet at *http://www.epa.gov/ORD/WebPubs/final.*

The result of these inclusive, transparent planning efforts is a robust research program that identifies ORD's areas of research emphasis in support of EPA's mission to protect human health and the environment.

Many of our ***highest-priority*** research areas continue to be those identified in the *1997 Update to ORD's Strategic Plan*. While we have accomplished a great deal in these areas since then, more remains to be done to provide the best possible scientific basis for environmental decision-making. The following is a brief discussion of ORD's eight highest-priority research areas, described within the context of EPA's goals.

EPA Goal 1: Clean Air



Particulate Matter

In July 1997, EPA revised the National Ambient Air Quality Standard (NAAQS) for particulate matter (PM), recognizing that exposure to both fine and coarse fraction particles is associated with adverse health effects. The basis for these revisions was new epidemiological evidence of increased illness and death associated with exposure to PM. The health risks estimated from current PM exposures represent thousands to tens of thousands of premature deaths each year.

Significant scientific uncertainties remain, however, about the biological mechanisms that cause increased mortality or morbidity from PM exposures. Many studies are underway to identify and evaluate mechanistic hypotheses and to explore exposure-dose-response relationships. In addition, improving our estimates of potential PM risks requires research to better measure and characterize PM exposure (i.e., who is exposed and at what levels). Lastly, research to quantify and control PM sources is the central focus of risk management research efforts.

ORD's PM research program is devoted to the mission of providing an improved scientific basis for periodic review and revision as needed of the NAAQS (i.e., effects, exposure, and risk assessment) and

implementation and attainment of the NAAQS (i.e., risk management). Our program is focused on human health rather than ecological concerns, with complementary research on PM-associated ecological effects (e.g., acid deposition) addressed under ecosystem protection programs. Key research questions include the following:

- What characteristics of PM (e.g., size, composition) produce toxicity and by what mechanisms?
- What is the role of PM alone and in combination with gaseous copollutants in producing health effects?
- What subpopulations are most sensitive to PM health effects, and what are the levels of exposure for these groups?
- What are the sources of PM, and how can we best estimate the atmospheric transformation and fate of PM and precursors to support control strategy development?

EPA Goal 2: Clean and Safe Water

Safe Drinking Water

Disinfection of drinking water has been one of the greatest public health success stories of the twentieth century. Nevertheless, care must be taken to ensure our drinking water is safe. For example, the occurrence of waterborne disease outbreaks in the United States demonstrates that the safety of drinking water can still be compromised by waterborne pathogens (e.g., cryptosporidium) if treatment is inadequate. Concerns have also been raised about chemical contaminants in our drinking water supply. Surface water and groundwater sources may be contaminated with many different natural substances (e.g., arsenic) and synthetic substances (e.g., pesticides) that may pose a risk. Even the disinfection process itself can lead to the formation of a number of potentially toxic organic and inorganic chemical by-products. Some subpopulations, such as infants and children or those with weakened immune systems, are known to be particularly sensitive to the effects of many waterborne pathogens and chemicals.

The 1996 Amendments to the Safe Drinking Water Act require EPA to conduct research to provide a strong scientific foundation for standards that limit public exposure to specific drinking water contaminants. In response to this requirement, ORD has established an integrated, multidisciplinary research program to address the following key questions:

- What are the microbiological and chemical contaminants of greatest public health concern? What are the effects caused by exposure to these agents?
- What analytical methods are needed to adequately estimate the occurrence of contaminants in drinking water? What are the levels of contaminants to which people are actually exposed?
- How can the risks posed by pathogens, individual chemicals, and mixtures of contaminants be characterized?
- What are the most cost-effective treatment methods to minimize or remove contaminants from drinking water? How can the quality of treated water be maintained in the distribution system, and how can source water be adequately protected?

Clean Water

The health and sustainability of aquatic ecosystems and their ecological components are affected by chemical, biological, and physical stressors. These stressors can result both from point sources of pollution or by disturbances in the watersheds.

Table 1: EPA's Strategic Goals

Goal 1: Clean Air — The air in every American community will be safe and healthy to breathe. In particular, children, the elderly, and people with respiratory ailments will be protected from health risks of breathing polluted air. Reducing air pollution will also protect the environment, resulting in many benefits, such as restoring life in damaged ecosystems and reducing health risks to those whose subsistence depends directly on those ecosystems.

Goal 2: Clean and Safe Water — All Americans will have drinking water that is clean and safe to drink. Effective protection of America's rivers, lakes, wetlands, aquifers, and coastal and ocean waters will sustain fish, plants, and wildlife, as well as recreational, subsistence, and economic activities. Watersheds and their aquatic ecosystems will be restored and protected to improve public health, enhance water quality, reduce flooding, and provide habitat for wildlife.

Goal 3: Safe Food — The foods Americans eat will be free from unsafe pesticide residues. Particular attention will be given to protecting sub-populations that may be more susceptible to adverse effects of pesticides or have higher dietary exposures to pesticide residues. These include children and people whose diets include large amounts of noncommercial foods.

Goal 4: Preventing Pollution and Reducing Risk in Communities, Homes, Workplaces, and Ecosystems — Pollution prevention and risk management strategies aimed at eliminating, reducing, or minimizing emissions and contamination will result in cleaner and safer environments in which all Americans can reside, work, and enjoy life. EPA will safeguard ecosystems and promote the health of natural communities that are integral to the quality of life in this nation.

Goal 5: Better Waste Management, Restoration of Contaminated Waste Sites, and Emergency Response — America's wastes will be stored, treated, and disposed of in ways that prevent harm to people and to the natural environment. EPA will work to clean up previously polluted sites, restore them to uses appropriate for surrounding communities, and respond to and prevent waste-related or industrial accidents.

Goal 6: Reduction of Global and Cross-Border Environmental Risks — The United States will lead other nations in successful, multilateral efforts to reduce significant risks to human health and ecosystems from climate change, stratospheric ozone depletion, and other hazards of international concern.

Goal 7: Quality Environmental Information — The public and decision makers at all levels will have access to information about environmental conditions and human health to inform decision making and help assess the general environmental health of communities. The public will also have access to educational services and information services and tools that provide for the reliable and secure exchange of quality environmental information.

Goal 8: Sound Science, Improved Understanding of Environmental Risk, and Greater Innovation to Address Environmental Problems — EPA will develop and apply the best available science for addressing current and future environmental hazards as well as new approaches toward improving environmental protection.

Goal 9: A Credible Deterrent to Pollution and Greater Compliance with the Law — EPA will ensure full compliance with laws intended to protect human health and the environment.

Goal 10: Effective Management — EPA will maintain the highest-quality standards for environmental leadership and for effective internal management and fiscal responsibility by managing for results.

Table 2: ORD's Research is Aligned with EPA's Strategic Goals

EPA Goal 10 : Effective Management
EPA Goal 9 : A Credible Deterrent to Pollution and Greater Compliance with the Law
EPA Goal 8 : Sound Science, Improved Understanding, and Greater Innovation
EPA Goal 7 : Quality Environmental Information
EPA Goal 6 : Reduction in Global Risks
EPA Goal 5 : Waste Management and Restoration
EPA Goal 4 : Safe Communities
EPA Goal 3 : Safe Food
EPA Goal 2 : Clean and Safe Water
EPA Goal 1 : Clean Air

ORD Multi-Year Plan	1	2	3	4	5	6	7	8	9	10
Particulate Matter *	●			○			○	○		
Air Toxics	●		○	○	○	○	○	○		
Tropospheric Ozone	●			○		○	○	○		
Drinking Water *		●	○	○			○	○		
Water Quality *		●		○	○		○	○		
Safe Food			●	○			○	○		
Safe Communities	○			●			○	○		
RCRA Waste Management	○			○	●		○	○		
Contaminated Sites		○			●		○	○		
Global Change *						●	○	○		
Ecosystem Assessment and Restoration *	○	○		○	○	○	○	●		
Human Health Risk Assessment *	○	○	○	○	○	○	○	●		
Mercury	○	○	○		○	○	○	●		
Endocrine Disrupting Chemicals *	○	●	●	●	○		○	●		
Socioeconomics	○	○	○	○	○	○	○	●		
Pollution Prevention and New Technologies *	○	○	○	●	●	○	○	●		

* The topics addressed in these multi-year plans are ORD's highest research priorities
● Directly contributes to meeting this EPA Strategic Goal
○ Supports achievement of this EPA Strategic Goal

Protecting and enhancing the integrity of aquatic ecosystems and their biotic components require research on quantifying impacts and understanding cause-and-effect relationships.

ORD's research focuses on the development of watershed diagnostic methods and understanding the importance of critical habitats and the impacts of habitat alteration on aquatic communities. In addition, ORD's research provides the scientific foundation supporting the development of water quality criteria and total maximum daily loads (TMDLs), including the development and refinement of models, understanding chemical stressors such as nutrients and toxic chemicals in both water and sediments, and the impact of sedimentation on aquatic ecosystems. Research on the impacts of wet weather flows offers a technology focus for the mitigation of the unique impacts of these stresses.

There are five critical ecological research questions for water quality. These are:

- How can numerical nutrient criteria be formulated to protect natural waters from the harmful impacts of excessive loadings of nitrogen and phosphorus?
- Can population dynamic models be refined to estimate the cumulative risks of critical habitat disturbance and contaminated sediments on the integrity of fish, shellfish, and other communities?
- Can diagnostic indicators and models be assembled into a decision-support system to accurately prescribe mitigation and restoration options for TMDLs?
- How can chemical criteria be incorporated into site-specific risk assessments for the protection of aquatic life, wildlife, and birds from toxic chemicals?
- Can methods for controlling pathogens, sediments, and toxic chemicals arising from point and non-point sources be integrated into a comprehensive watershed management approach?

EPA Goal 6: Reduction of Global and Cross-Border Environmental Risks

Global Change

The earth's environment is constantly changing due to the complex interplay of natural processes and human activities. Changes in climate, climate variability, land use, and ultraviolet B band radiation are all occurring on a global scale. The potential consequences of these changes are wide ranging and could adversely affect human health, ecosystems, and socioeconomic sectors, all of which are vital to sustainable development. Recognizing that policy makers and resource managers are making decisions today that have important long-term ramifications for our global environment, the Global Change Research Program seeks to inform decision-making processes by providing comprehensive assessments of potential long-term consequences of global change.

PA is one of the member agencies of the U.S. Global Change Research Program (USGCRP), which is focused on understanding the Earth system as a whole and the dynamics of environmental change and connecting that knowledge to societal needs. Within the USGCRP, PA's principal role is to assess the potential consequences of global change on human health, ecosystems, and socioeconomic systems in the United States. This entails: improving the scientific basis for evaluating effects of global change in the context of other environmental stressors and human activities; conducting assessments of the risks and opportunities presented by global change; and assessing adaptation options to improve society's ability to effectively respond to change.

ORD's Global Change Research Program is focusing on those areas where EPA has the most to offer—assessments of the consequences of global change on air quality, water quality, human health, and ecosystem health. Therefore, researchers are addressing the following scientific questions:

- What are the potential consequences of global change on vector- and water-borne weather-related morbidity and health effects related to air pollution, especially tropospheric ozone and PM?

- What are the potential effects of global change on aquatic ecosystems, invasive nonindigenous species, and ecosystem services?

- How may global change affect air quality, especially tropospheric ozone and PM? How will global change affect cities' ability to meet Clean Air standards?

- What are the potential impacts of global change on pollutants and microbial pathogens in aquatic resources?

Goal 8: Sound Science, Improved Understanding of Environmental Risk, and Greater Innovation to Address Environmental Problems

It should be noted that most of the core research conducted under this Goal also provides direct support to the objectives of other EPA Strategic Goals. For example, the work done under Human Health Risk Assessment to address cumulative risk will directly support requirements of the Food Quality Protection Act covered under EPA Goal 3: Safe Food.

Research to Improve Ecological Risk Assessment and Management

Natural ecosystems are under constant stress from a variety of factors: pollutants through air, water, and soil; alteration or fragmentation resulting from urban sprawl and resource extraction; nonindigenous species; and global change, to name a few. These "stressors" act synergistically and/or antagonistically, both with each other and with natural processes, at scales that range from local to global. Many of the mechanisms by which stressors act on and alter ecosystems are poorly understood or quantified, as are their immediate and long-term impacts, creating uncertainties in environmental decision-making, such as whether to protect, exploit, conserve, or restore natural resources and processes.

The goal of ORD's ecological research program is to provide scientific leadership and knowledge for assessing, improving, and restoring the integrity of ecosystems. The program addresses the following fundamental research questions:

- What are the most efficient and effective indicators, monitoring systems, and designs for measuring the exposures of ecosystems to multiple stressors and the resulting responses of ecosystems at local, regional, and national scales?

- How can we better identify and understand the processes that lead from stressors to effects? Can we develop models to predict the results of alternative actions on the future exposures and responses of ecosystems at the most relevant scales?

- What are the best assessment methods, indices, and guidelines for quantifying risks to ecosystems from multiple stressors at multiple scales?

- What are the most efficient and effective prevention, management, adaptation, and remediation technologies to manage, restore, or rehabilitate ecosystems to achieve local, regional, and national goals?

Research to Improve Human Health Risk Assessment and Management

Human health risk assessment is the process EPA uses to identify and characterize human health impacts associated with environmental exposures. There are many uncertainties associated with the risk assessment process due to limitations in available data on pollutant sources and exposures, and to limitations in our current understanding of the physical, chemical, and biological processes that relate human exposure, dose, and response.

The overarching goal of ORD's human health risk assessment research is to improve our scientific knowledge base and to develop risk assessment methodologies to enable the Agency to more accurately assess and characterize hazards and risks to the general population and vulnerable subgroups, such as children and communities that practice subsistence lifestyles, from exposures to single pollutants from multiple sources and multiple pathways (i.e., aggregate risks) and cumulative risks from exposures to multiple stressors by increasing the use of measured data and mechanistic information.

To meet this long-range Goal, ORD's health risk assessment research program is contributing to answering the following questions:

- How can we improve our mechanistically based understanding of toxicities and susceptibilities foq the general population and subpopulations such as children, the elderly, and persons with pre-existing diseases?
- What are the relevant biomarkers of exposure, dose, effect, and susceptibility and theiq relationships?
- What is the biological basis for adverse health effects in children, especially asthma?
- What are the interactive effects from exposures to chemical mixtures with common or different modes of action?
- How can we develop improved models and methodologies to better estimate human exposures, assess aggregate exposures to single stressors, and assess cumulative risks from exposures to multiple stressors?
- How can we develop more consistent and harmonized risk assessment approaches and methods for all human health endpoints, with special attention to different durations and patterns of exposure and life stages?
- How can we conduct research to evaluate the consequences of environmental risk management decisions on public health?

Endocrine Disrupting Chemicals

In recent years, there has been growing scientific concern and public awareness regarding the potential of some chemicals in the environment to cause adverse health effects in human and wildlife populations by interacting with the endocrine system. Collectively these substances are known as endocrine disrupting chemicals (EDCs). It has been hypothesized that exposure to EDCs might result in a variety of adverse effects, including cancers that may be mediated by endocrine mechanisms, developmental or reproductive disorders, neurological impairment, immune dysfunction, and thyroid damage.

There are numerous examples of adverse effects of EDCs on wildlife such as birth defects in fish-eating birds exposed to polychlorinated biphenyls (PCBs) in Lake Michigan, mortality of young Lake Ontario trout as a result of exposure to dioxin-like chemicals, abnormal reproductive development in Lake Apopka alligators following contamination by a pesticide. In humans, the

impact of prenatal exposure to diethylstilbestrol (DES) on the reproductive tract of both male and female offspring is well documented. In addition, studies have demonstrated that PCBs cause neurodevelopmental impairment in exposed children.

Despite these reported effects, there is little known about their causes and what effects may result in the human and wildlife populations from exposures to ambient environmental concentrations of EDCs. However, it is known that the endocrine system plays an important role in normal growth, development, and reproduction and that small perturbations in endocrine status, during critical periods, could have profound and long-reaching impacts. Based on the potential scope of the EDC problem, the possibility of serious effects on the health of human and wildlife populations, the persistence of some EDCs in the environment, and the widespread global concern about their fate and transport over national boundaries, this area is a high-priority for ORD research.

Key areas of uncertainty and research questions include the following:

- How, and to what degree, are human and wildlife populations exposed to EDCs? What effects are occurring in exposed human and wildlife populations?

- Do current testing guidelines adequately evaluate potential endocrine-mediated effects?

- What are the dose-response characteristics at environmentally relevant concentrations?

- What are the major sources and environmental fates of EDCs?

- How can unreasonable risks be managed? Are new technologies needed?

Pollution Prevention and New Technologies

Pollution prevention, or anticipating and avoiding human health and environmental problems before they occur, offers a proactive alternative to the legal mandates and command and control regulations traditionally used to protect the environment. The goal of pollution prevention research is to provide more flexible, low-cost, and less polluting alternatives to address the pollution challenges facing the United States and the world in the twenty-first century.

Development of new pollution prevention tools and technologies, verification of new environmental technologies, and research that advances the fundamental understanding of the economic and behavioral sciences as they relate to the environment are important components of ORD's pollution prevention and new technologies research program. This research program relies on substantial stakeholder input and participation as a means of identifying those human health and environmental problems most conducive to innovative, alternative approaches to environmental protection. Because of the broad applicability of this research program and its potential for realizing significant economic and environmental benefits, pollution prevention and new technology for environmental protection are extremely important risk management components of ORD's research agenda.

Research in this area focuses on four important questions:

- What pollution prevention technologies and approaches can be employed in various economic sectors, particularly on industrial and consumer products, to advance "green" processes and clean technologies?

- What tools and methodologies can be applied in various economic sectors to utilize the most cost-effective pollution prevention technologies and approaches to protect ecosystems?

- How best can the performance of private sector products, technologies, and approaches that address human health and environmental problems be verified using a high-quality and efficient program to target important performance and operational characteristics?

- What are the socioeconomic and behavioral aspects of decision-making that foster the adoption of pollution prevention by the public and private sector at all levels (e.g., local, state, regional) to manage human health and environmental risks?

Achieving Our Future, Making a Difference

Implementing This Strategic Plan

Developing this *Strategic Plan* is only the first step of our effort. To be successful, we must execute this *Plan* to its full extent. We will develop an implementation plan that sets priorities, assigns clear responsibility and deadlines, and commits resources to carry out the actions described in this *Plan.* This implementation plan will be specific as to how and when we will move from our current state to the organization we envision and intend to be.

We will implement this *Plan* on both the national and local levels, taking steps to ensure that the actions are completed and that our objectives are achieved. In implementation, the *Strategic Plan* will be a key component of all of our planning processes, thereby ensuring that we provide both the resources and attention to the commitments that we have made in the *Plan.* The goals of: (1) supporting the Agency; (2) high-performance; (3) scientific leadership; (4) integration; and (5) anticipating the future will be used to frame our research planning and prioritization, as well as our resource allocation and workforce planning.

We see the *Strategic Plan* as having far-reaching effects on our organization, infusing itself into all aspects of our operation. As such, we will also ensure that each level of the organization is aware of and is fully participating in achieving our goals. Each organization's management team will be responsible for evaluating how best to incorporate the tenets, goals, objectives, and actions into their organization's activities.

To measure and assess our progress toward achieving our goals, we will regularly track the measures of success that we have included in the *Plan.* We will use this information to evaluate what is working and what needs improvement, and make adjustments accordingly. As necessary, we will revisit our objectives and actions in light of our progress and changing external circumstances. Moreover, we will communicate our progress regularly to our customers and stakeholders and learn from them and other organizations how we might improve implemention of this *Plan.* In so doing, we will hold ourselves accountable to our customers, stakeholders, and each other for achieving our goals and future success.

The Future We Seek

Successfully achieving the goals of the *Strategic Plan* will mean an organization where:

- Our close relationships with EPA's program and regional offices allow us to assess and anticipate their needs and collaborate to provide scientific research and technical assistance to achieve greater environmental protection;

- Investment in our workforce and organizational processes has led to a staff who are motivated, trained, and equipped in their work to achieve the best results;

- Our leadership capabilities and accomplishments are recognized by providing world-class science, being influential in the development of a national environmental research agenda, and being at the cutting edge of proactive environmental protection;

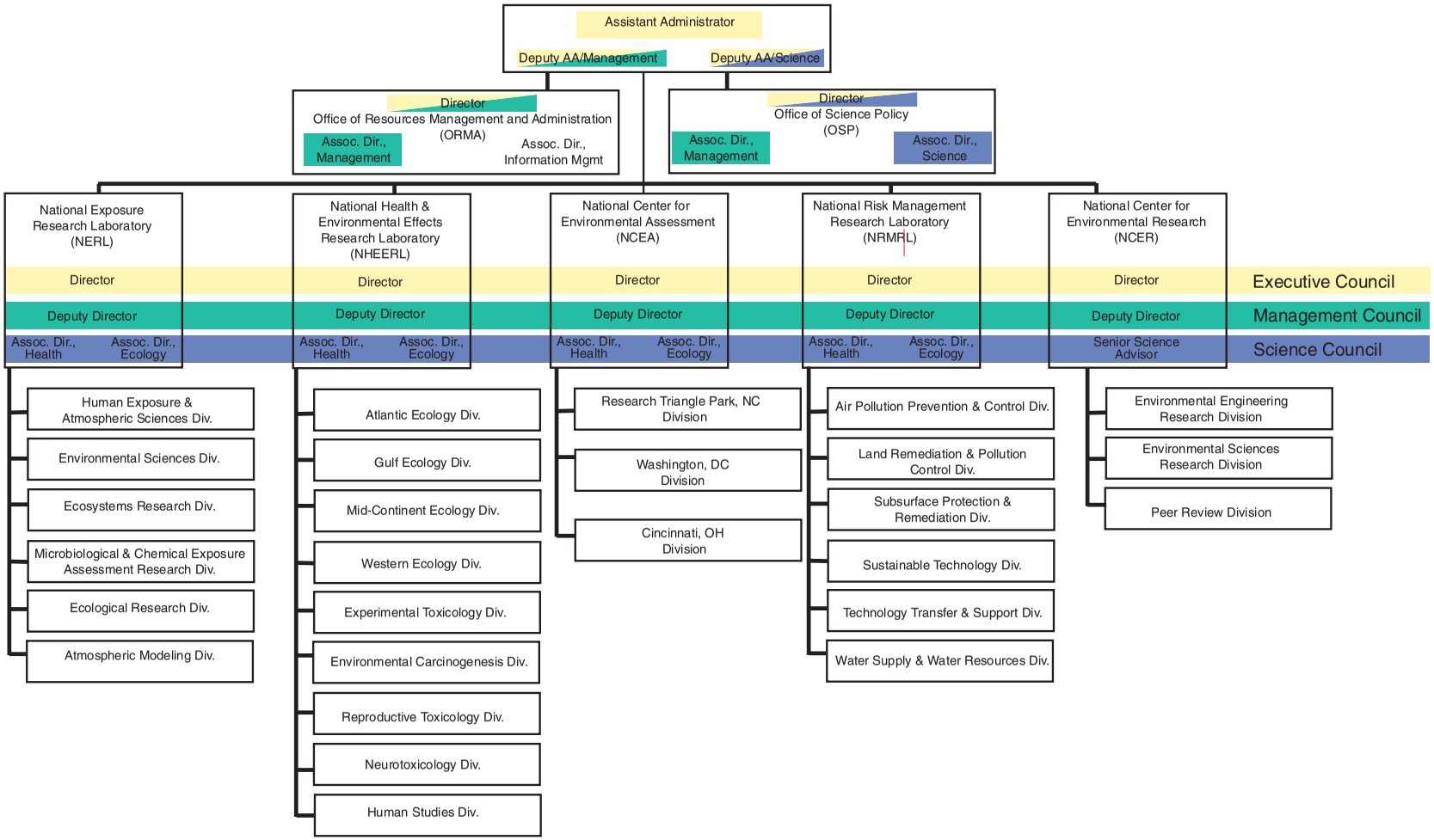
- Our capacity to integrate across all aspects of a problem provides comprehensive solutions to complex problems; and

- Our ability to anticipate and provide solutions to future environmental issues before their adverse effects are widely known or detected averts potentially dangerous or expensive environmental problems.

This is the future we seek and the commitment we make to achieve this vision.

Appendices

Appendix A:
Office of Research and Development Organizational Chart*



*This Organizational Chart is detailed to the Division level.

Appendix B: Acronyms and Abbreviations

BOSC	Board of Scientific Counselors
EDCs	Endocrine Disrupting Chemicals
EPA	U.S. Environmental Protection Agency
DES	Diethylstilbestrol
GPRA	Government Performance and Results Act of 1993
NAAQS	National Ambient Air Quality Standards
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
NRC	National Research Council
NRMRL	National Risk Management Research Laboratory
ORD	Office of Research and Development
ORMA	Office of Resources Management and Administration
OSP	Office of Science Policy
PCBs	Polychlorinated Biphenyls
PM	Particulate Matter
RCRA	Resource Conservation and Recovery Act
SAB	Science Advisory Board
STAR	Science to Achieve Results
TMDL	Total Maximum Daily Load
USGCRP	U.S. Global Change Research Program

For more information, please access the
Office of Research and Development Web site at:

www.epa.gov/ORD

This document is available on ORD's Web site at:

www.epa.gov/ORD/SP

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