



FY 2003 PRESIDENTIAL SCIENCE AND TECHNOLOGY BUDGET REQUEST FOR THE ENVIRONMENTAL PROTECTION AGENCY; AN SAB REVIEW

**A REVIEW BY THE RESEARCH
STRATEGIES ADVISORY
COMMITTEE (RSAC) OF THE
US EPA SCIENCE ADVISORY
BOARD (SAB)**



**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460**

March 29, 2002

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**OFFICE OF THE ADMINISTRATOR
SCIENCE ADVISORY BOARD**

Honorable Christine Todd Whitman
Administrator
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW
Washington, DC 20460

Subject: Review of the FY2003 Presidential Science and Technology Budget Request for the Environmental Protection Agency: An EPA Science Advisory Board Review

Dear Governor Whitman:

On February 20 and 21, 2002 the Research Strategies Advisory Committee (RSAC) of the US EPA Science Advisory Board (SAB) met to review the Science and Technology component of the FY2003 Presidential Budget Request for the US Environmental Protection Agency (EPA). As in past years, this report was developed by the entire RSAC in a rapid response fashion so the report would be available for the House Science Committee's Congressional hearing on EPA's Science and Technology budget. RSAC's report was approved by SAB's Executive Committee during a public meeting on March 6, 2002.

As part of the review process, the RSAC responded to five charge questions:

- a) Does the budget request reflect priorities identified in the EPA and ORD Strategic Plans?
- b) Does the budget request reflect coordination between ORD and the Program Offices, including identification of the science needed to support major upcoming rules and decisions?
- c) Does the President's Budget request provide adequate balance and attention to the core and problem driven research needed to provide satisfactory knowledge for current and future decisions EPA will be required to make?
- d) Is the EPA research and development program addressing the important issues needed to meet EPA's strategic objectives and protect human health and the environment in the US and globally? What important issues are not receiving adequate attention at the requested level of resources provided for the R&D program and the S&T budget?

- e) How can EPA better use measures of performance that focus on environmental outcomes to identify the impact of its research and development program and the funds that Congress provides for that Program?

Overall, on the basis of its review, RSAC notes that:

- a) both EPA and ORD have specific Strategic Plans that continue to increasingly guide their research activities
- b) EPA has made much progress identifying major programmatic needs
- c) improvement in coordination between ORD and the Program Offices continues
- d) there has been satisfactory progress in accounting for the impact of research efforts and,
- e) initial progress has been made to define short-term and intermediate outcomes of the EPA ORD research activities

RSAC strongly recommends the EPA and ORD “stay the course” and continue to make progress with these efforts.

Further, while detailed responses to the charge questions are found in the body of the report, the major findings and recommendations are:

- a) RSAC was pleased to see a preliminary strategy for recruiting both junior and established productive investigators to the Agency, although the committee continues to have concerns that much of ORD's talent in certain areas may be diminished by retirement. The recruitment and retention of post-docs at the Agency has been quite successful and already borne fruit; young bright talent from this pool of trainees has remained in the Agency.

RSAC recommends that EPA continue this post-doctoral program or a similar one. In addition, RSAC recommends that ORD continue to explore, and ultimately implement, a career path and recruitment program modeled after the comparable NIH program.

- b) The Committee is deeply concerned with the transfer of funds that support the STAR Fellowship program to another Agency. This action is unlikely to result in support of research that is responsive to Agency needs in environmental science and policy, is inconsistent with ORD's Strategic Plan and undermines the goals stated in the Plan including Goal 2 which has the specific objective to "recruit, retain, and develop a highly qualified and diverse workforce". RSAC urges the Agency and Congress to find approaches to continue funding of the STAR Fellowship Program at EPA.

- c) RSAC recognizes that there is more science being conducted at EPA than is identified in the S&T and the ORD budgets. Therefore, RSAC again recommends that EPA continue with its Science Inventory efforts which catalogue science projects and products, so as to capture and identify the extent of science being done at EPA. RSAC recommends that this process continue to be expanded to include development of an overall science planning process for the Agency that uses the Science Inventory as reference.
- d) RSAC recommends that EPA identify specific non-regulatory driven issues of high importance to protecting human health, the environment, and ecosystems and in the next budget (FY 2004) request adequate S&T funds to address approaches to mitigate such risks. In addition, RSAC urges Congress to seriously consider such budget requests and to provide needed budget, personnel and (if needed) legislation to allow EPA to address such risks.
- e) RSAC strongly recommends that if Congress adds specific projects or programs for EPA, Congress also appropriate the funds needed for the successful completion of the projects or programs it adds on to the S&T program budget as was done in the current fiscal year appropriations. This Congressional action will minimize impacts on the already scarce S&T budget for EPA.
- f) RSAC encourages EPA to maintain and increase the investment in research needed to meet the needs of the Agency. This is particularly important in emerging scientific areas such as genomics, proteomics and bioinformatics. RSAC continues to recommend that the Agency be vigilant in defining and maintaining the core research needed to achieve a balanced S&T research program.

Further, RSAC suggests that the Agency take steps to evaluate whether the mix of risk mitigation and risk characterization research is adequate to achieve the Agency's strategic goals. It was not clear from the materials provided to the committee that there is adequate research funding to ensure technological developments to mitigate existing risks and forestall the introduction of new ones. Further coordination of research planning efforts may be required to ensure the mix of risk characterization and mitigation research is appropriate.

As noted in our report to you last year, RSAC has launched an ongoing process to evaluate the total S&T budget and funding needs in the context of its evaluation of the Agency's multiyear plans and science inventory. We are also considering the science available in the larger scientific community outside of EPA, and how the Agency identifies, accesses and uses this information. We discussed this with Deputy Administrator Fisher who expressed an interest that RSAC pursue three other key questions to provide an ongoing focus for the Committee's activities:

- a) How does EPA capture and use scientific knowledge generated by other organizations (federal agencies, state agencies, industry, universities, private organizations) in its multi-year planning efforts for the EPA research and development program?

- b) To what extent is there adequate peer review of the science available for policy and regulatory decisions at EPA, particularly peer review of the planning for the R&D program and of the products from the R&D program?
- c) What is the assessment of the committee (RSAC) of the quality of the science being done at EPA, particularly that supported by the S&T budget?

Some comments related to these questions are provided in Section 2.7. It is our intent to further address these and other relevant issues in subsequent meetings. We will keep you informed of our efforts.

We appreciate the opportunity to review and provide advice on the Science and Technology component of the FY2003 Presidential Budget for EPA. The Research Strategies Advisory Committee would be pleased to expand on any of the findings described in our report, and we look forward to your response.

In closing, it is well recognized that in recent years the Agency has been assigned ever more responsibilities. This has also been accompanied by calls to increase the extent to which Agency action is based on “sound science”. The only way in which it will be possible to meet the expanded responsibilities, while improving the quality of the science used, is for the S&T budget to be maintained an increased over time. The Committee urges the Agency to clearly explain this need to the OMB and to Congress.

Sincerely,

/ Signed /

Dr. William H. Glaze, Chair
EPA Science Advisory Board

/ Signed /

Dr. Raymond C. Loehr, Chair
Research Strategies Advisory Committee
EPA Science Advisory Board

NOTICE

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ABSTRACT

The Research Strategies Advisory Committee (RSAC) of the Science Advisory Board (SAB) met February 20 and 21, 2002 to review the Science and Technology portion of the FY 2002 Presidential Budget Request for the U.S. Environmental Protection Agency . The committee notes that both EPA and ORD have specific Strategic Plans that continue to increasingly guide their research activities. It also notes that EPA has made much progress identifying major programmatic needs, and that improvement in coordination between ORD and the Program Offices continues. RSAC observes that there has been satisfactory progress in accounting for the impact of research efforts, and that initial progress has been made to define short-term and intermediate outcomes of the EPA ORD research activities.

RSAC is encouraged by the success of the ORD post doctoral program, but is deeply concerned with the transfer of funds that support the STAR Fellowship program to another Agency. RSAC urges the Agency and Congress to find approaches to continue funding of the STAR Fellowship Program at EPA. The other RSAC recommendations are that:

- a) EPA continue with its Science Inventory efforts which catalogue science projects and products, so as to capture and identify the extent of science being done at EPA.
- b) EPA identify specific non-regulatory driven issues of high importance to protecting human health, the environment, and ecosystems and in the next budget (FY 2004) request adequate S&T funds to address approaches to mitigate such risks.
- c) if Congress adds specific projects or programs for EPA, Congress should also appropriate the funds needed for the successful completion of the projects or programs it adds on to the S&T program budget as was done in the current fiscal year appropriations.

RSAC encourages EPA to maintain and increase the investment in research needed to meet the needs of the Agency. This is particularly important in emerging scientific areas such as genomics, proteomics and bioinformatics. RSAC continues to recommend that the Agency be vigilant in defining and maintaining the core research needed to achieve a balanced S&T research program. Further, the Committee urges the Agency to clearly explain to OMB and Congress that the only way it will be possible to meet its expanded responsibilities while improving the quality of the science used, is for the S&T budget to be maintained and increased over time.

Keywords: GPRA, budget, research, strategic planning

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EPA Science Advisory Board
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1. INTRODUCTION

1.1 Background and Schedule

RSAC is composed of senior members of the SAB, including past chairs, and it includes members from most of the other standing committees of the Board. The Committee has reviewed the Office of Research and Development's (ORD) budget request annually for more than a decade. This is the fourth year that all of the Science and Technology (S&T) components in Agency Program Offices were reviewed, and it is the fourth year that a GPRA goal-based budget was presented. The purpose of this review is to provide the Agency and Congress with advice and insight on the adequacy of the FY 2003 President's budget request to implement a science program of high quality that is responsive to EPA's needs. The Committee was provided with background documents supplied by the Agency, supplemented by briefings from Agency senior managers and presentations from staff of the House Science Committee, the American Association for the Advancement of Science and the American Chemical Society during the meeting.

The Science Advisory Board (SAB) review of the proposed Science and Technology budget for the Environmental Protection Agency is an annual event. The timing associated with the public availability of the budget materials often makes scheduling of a formal review difficult. Reviews completed by RSAC also require formal public review and approval by the SAB's Executive Committee. This year, the budget materials were released in early February, with various review materials made available to the Committee between February 4 and February 14. The Committee met on February 20 and 21, 2002, with formal review and approval of its report by the Executive Committee on March 6, 2002.

Generally, the Chair or another Member of the RSAC provides expert testimony to the House Committee on Science during its annual budget hearings, which are normally scheduled shortly after the release of the proposed budget. This year's budget hearing will be held in April with Dr. Raymond Loehr, RSAC Chair, testifying on behalf of the committee and the Board.

This year RSAC reviewed the S&T and the ORD Fiscal Year 2003 budget categories. EPA's Science and Technology Program is designed to produce the necessary scientific knowledge and tools to support decisions on preventing, abating or regulating environmental pollution and to advance the base of understanding in the environmental sciences.

The Agency's science and technology efforts are conducted through contracts, grants, and cooperative agreements with universities, industries, other private commercial firms, nonprofit organizations, State and local governments, and Federal agencies, as well as through work performed at EPA's 12 laboratories and various field stations and field offices. The S&T account funds activities such as developing and improving sampling and analytical methods and instruments for measuring pollutants; determining the effects of pollutants on animals, plants, materials, and the general environment; researching the processes that lead to pollution; evaluating technologies for preventing and controlling pollution; and developing guidelines and research tools to improve risk assessments. This account also provides for S&T operating expenses such as personnel salary and benefits, laboratory supplies and materials, operation and

maintenance of lab facilities, equipment, Automatic Data Processing (ADP) support, human resource development, and printing. Beginning in FY 1996, this account also funds Hazardous Substance research formerly appropriated in the Superfund account.

RSAC recognizes that there is more science being conducted at EPA than is identified in the S&T and the ORD budgets. Therefore, RSAC again recommends that EPA continue with its Science Inventory efforts which catalogue science projects and products, so as to capture and identify the extent of science being done at EPA. RSAC recommends that this process continue to be expanded to include development of an overall science planning process for the Agency that uses the Science Inventory as reference.

Overall, on the basis of its review, RSAC notes that:

- a) both EPA and ORD have specific Strategic Plans that continue to increasingly guide their research activities
- b) there has been much progress on identifying the major programmatic needs
- c) improvement in coordination between ORD and the Program Offices continues
- d) there has been satisfactory progress in accounting for the impact of research efforts, and
- e) initial progress has been made to define short-term and intermediate outcomes of the EPA ORD research activities

RSAC strongly recommends the EPA and ORD “stay the course” and continue to make progress with these efforts.

1.2 Charge to the Committee

- a) Does the budget request reflect priorities identified in the EPA and ORD Strategic Plans?
- b) Does the budget request reflect coordination between ORD and the Program Offices, including identification of the science needed to support major upcoming rules and decisions?
- c) Does the President’s Budget request provide adequate balance and attention to the core and problem driven research needed to provide satisfactory knowledge for current and future decisions EPA will be required to make?
- d) Is the EPA research and development program addressing the important issues needed to meet EPA’s strategic objectives and protect human health and the environment in the US and globally? What important issues are not receiving adequate

attention at the requested level of resources provided for the R&D program and the S&T budget?

- e) How can EPA better use measures of performance that focus on environmental outcomes to identify the impact of its research and development program and the funds that Congress provides for that Program?

Responses to these questions, and to other issues the Committee wishes to address, are provided to both the Agency and the Congress.

1.3 Format of this Report

Following this Introduction, the report provides specific responses to the questions in the Charge to the Committee (Chapter 2).

2. RESPONSE TO THE CHARGE

2.1 Alignment Between Budget Priorities and Strategic Plans

Charge Question: Does the budget request reflect priorities identified in the EPA and ORD Strategic Plans?

The answer to this question is yes. The budget request generally reflects the priorities identified in the EPA and ORD strategic plans. However, it is difficult to address this charge question in detail with the information presented to RSAC. A more complete answer to the question would be facilitated by constructing a matrix listing the research priorities extracted from each of the ORD Strategic Plan goals and mapping them against the corresponding enacted FY 2002 and requested FY 2003 S&T funding for each research priority. Organization of materials in this manner for future budget reviews would help RSAC answer this charge question more thoroughly.

The Presidential Science and Technology (S&T) budget request for EPA was similar to the levels requested in the last three years. The S&T budget request increased by \$46 million from last year's enacted budget primarily due to additional funds for the Homeland Security Program. RSAC found the funding request priorities to be consistent with the environmental goals established in the Agency Strategic Plan. However, RSAC remains concerned about ORD's ability to fully meet these environmental goals in future years within the limitations of a level budget that may force the Agency to not be able to fund projects and programs that are critically needed to meet GPRA goals and strategic objectives.

In terms of financial resources, the S&T component of the total Agency budget (i.e., for ORD plus the Program Offices) is approximately 10%. This percentage has remained approximately the same for more than a decade. RSAC notes that the current and future environmental and health problems have become increasingly complex. For instance, many of the pressing environmental problems are not separate air or water media-specific problems, rather they are integrated multi-media problems. As another example, the environmental problems facing humans and ecosystems are not chemical-specific. Rather they are system issues related to low environmental concentrations of mixtures of contaminants and other stressors.

The budget request for the Office of Research and Development alone for FY 2003 increased by \$92 million from the FY 2002 President's budget and by \$35 million from the FY 2002 enacted budget. As is the case for the overall EPA S&T budget, this increase is largely the result of funding for activities related to Homeland Security. RSAC is pleased to see this increase as it reflects the Committee's recommendation last year that ORD's budget be increased by 1% per year.

RSAC has the following comments on specific issues that need to be addressed by existing or new programs in order to make further progress towards the achievement of the Agency's and ORD's strategic goals.

- a) Risk Characterization and Risk Mitigation – Several of the Agency’s strategic goals involve both risk characterization and risk mitigation. In the early stages of the federal environmental program development in the United States, much greater emphasis was placed on characterization over mitigation because it could be plausibly argued that environmental and related human health problems had to be understood before they could be solved. New environmental problems arise continuously as a feature of increasing population, industrialization and globalization. Consequently, there will always be a need to characterize risk. However, the Agency should ensure that programs developed to satisfy strategic goals reflect the appropriate balance between risk characterization and risk mitigation.

- b) Extent of the Scope of Global Environmental Programs – RSAC applauds the Agency’s efforts on global climate change and associated technical activities. However, the Committee notes that Agency program plans do not cover some elements that naturally fit within its mandate to protect human health and the environment. It is recommended that the Agency use its mandate and its interactions with other agencies to act on such global environmental issues as environmental sustainability indexing, valuation of natural resources, industrial ecology, environmental aspects of natural disasters, and long-range transport of air-borne pollutants.

In developing programs to satisfy its strategic goals on international environmental programs, the Agency should ensure that it does not focus exclusively on regions in which the United States has terrestrial boundaries with other countries. Pollutants can come into the United States from very distant regions. For example, it is now becoming clear that significant quantities of air pollutants are being transported over the Pacific Ocean from the rapidly developing nations of eastern Asia such that these pollutants contribute to a rise in the “background” concentrations of criteria and other pollutants in non-attainment areas. Coordination with the appropriate countries to help identify the sources would allow EPA and the public to better understand source/receptor relationships that affect the U.S. population.

- c) Effective Workforce Development and Maintenance Strategy – RSAC has previously noted that nearly 50% of the ORD workforce is over the age of 50. To remain vital, the Agency must continue to assemble the next generation of Agency scientists and engineers. As one approach, in 1999, ORD began a multi-year effort to enhance the EPA workforce through its post-doctoral program. This program has been successful and has allowed EPA to:
 - i) bring fresh perspectives and new skills to the EPA research program,
 - ii) improve workforce diversity,
 - iii) assist with succession planning, and

- iv) contribute new ideas and concepts to important areas such as particulate matter research, ecological risk assessment and human exposure modeling.

RSAC recommends that EPA continue this post-doctoral program or a similar one. In addition, RSAC recommends that ORD continue to explore, and ultimately implement, a career path and recruitment program modeled after the comparable NIH program. This would allow ORD to recruit experienced researchers in areas targeted for development following a model where the researcher is given a 5-6 year appointment to develop a credible research program. As in academia, these scientists would not be provided permanent status (i.e. tenure) until the end of this period. It is RSAC's opinion that this approach would be a strong asset to the core research program of ORD. It would enhance the reputation of ORD in the scientific community and ultimately increase the credibility of the Agency's regulatory programs. It also provides an avenue for the recruitment of established scientists by offering market-based compensation packages.

In contrast to the above positive actions, RSAC is deeply concerned with the transfer of funds that support the STAR Fellowships program to another Agency. To have a continuing strong research and development program at ORD, it is imperative that there be an influx of younger competent researchers. The STAR Fellowships program, initiated in FY 1995, was seen as an efficient mechanism to substantially improve the quality of science and scientific staff within the Agency. At that time, it was recognized that existing NIH, NSF and other fellowship programs were not producing quality environmental scientists with solid ecological backgrounds. The track record is clear; the STAR Fellowships have produced numerous valuable contributions to Agency science. Because they have been administered by EPA they have supported a wide array of work that broadly responds to Agency needs in environmental science and policy. A fellowship program administered by another organization, such as NSF, will be influenced by a very different organizational culture, and will thus be much less likely to support work that is as supportive of, and responsive to, Agency needs. Further, the elimination of STAR Fellowships is inconsistent with ORD's Strategic Plan and undermines the goals stated in the strategic plan including Goal 2 – to be a high-performing organization – which has the specific objective to "recruit, retain, and develop a highly qualified and diverse workforce". RSAC urges the Agency and Congress to find approaches to continue funding of the STAR Fellowship Program at EPA.

2.2 Coordination Between ORD and the Program Offices

Charge question: Does the budget request reflect coordination between ORD and the Program Offices, including identification of the science needed to support major upcoming rules and decisions?

Yes. RSAC commends ORD on the development and implementation of its planning structure for research. The links with the Program Offices are solid and allow for better use of science in the regulatory arenas of the Program Offices. The Committee was impressed with the continued progress made by EPA to heighten the level of interaction between ORD and Program Offices. It appeared that ORD has structured its research activities based on its Strategic Plan but with consideration of the needs of the Program Offices within EPA.

Presentations from program staff and their discussions with the Committee supported RSAC's perception that there have been tremendous strides in communication between ORD and Program Offices. Representatives from the Office of Pollution Prevention, Pesticides and Toxic Substances; the Office of Air and Radiation; the Office of Water; and the Office of Solid Waste and Emergency Response all emphasized the collaborative environment that has been established by ORD. In future evaluations of the S&T account, it would be helpful for RSAC to know the research needs of the Program Offices that could not be met by ORD.

The Committee was also impressed by the comments in the presentations that the research outputs from ORD were being used for regulatory support by the Program Offices. The PM Research program was particularly impressive. It has produced many important results that begin to address the substantial uncertainties that the NRC identified as crucial research priorities following the promulgation of the PM 2.5 standard.

RSAC considers the ORD-OIG (Office of Inspector General) Pilot Program described during the presentations to be an excellent initial framework for monitoring research program progress and for measuring the impact of this research. When fully developed and applied to specific research programs, this model will provide a useful depiction of ORD's research with the Program Office needs by specifically identifying long-, intermediate-, and short-term outcomes, customers, resources, activities and outputs.

Additionally, ORD should explore better mechanisms for establishing liaisons with other federal agencies working in the environmental arena. Many of these agencies are conducting research in relevant areas that could obviously benefit from and synergize with EPA's programs. There is potentially much to gain from increasing liaisons with FDA, USFWS, USACE, BLM, NMFS, NIEHS, DOE, DOD, NIOSH, etc. The committee is aware that many collaborations between EPA and these and other agencies are underway but the nature and extent of these collaborations is not clear to RSAC. This would be a productive future topic for EPA discussion with the committee.

ORD should also consider enhanced liaisons with the private sector. Many industries and contract consulting firms have significant research expertise that would significantly complement EPA's efforts. A specific example is the area of Brownfields restoration. Industry has developed significant new and innovative approaches that could assist EPA efforts in this area.

Another suggestion is that a quality management plan could help the Agency better integrate the research program elements with its GPRA Goals. During the past few years, the

Agency has developed specific GPRA goals that set forth specific levels of environmental improvement to be achieved and indices of their measurement as a means of evaluating the success of its programs. It is recognized that GPRA goals cannot be met in most cases, in a single year of program implementation, and that some of the projects that are focused on research to understand environmental processes may not fit into the GPRA scheme. The Agency has developed a quality system that was reviewed by the Environmental Engineering Committee of the Science Advisory Board. It may be beneficial to apply that system to the budget development process in the future because it provides a mechanism for establishing project goals within program strategic plans, and for evaluating project outcomes within the context of stated strategic goals.

2.3 Balance Between and Attention to Core and Problem-Driven Research

Charge question: Does the President's Budget request provide adequate balance and attention to the core and problem driven research needed to provide satisfactory knowledge for current and future decisions EPA will be required to make?

The committee was not able to answer this question affirmatively in the time available and with the information provided. ORD feels that the research efforts identified as associated with Goal 8 of the Agency's Strategic Plan are mostly the core research projects. ORD also feels that its efforts associated with Goals 1-7 of the Agency Strategic Plan are more appropriately categorized as problem-driven research. With these definitions, the FY2003 ORD request allocates approximately 38% and 49% of the budget, respectively, to core (Goal 8) and problem-driven research areas (Goals 1 through 7) and this year 12% of the budget request is devoted to Homeland Security. This allocation is probably consistent with the balance recommended by the National Academy of Sciences (NAS) and with ORD's strategic plan. However, RSAC is concerned about the ORD's ability to maintain a balanced core and problem-driven S&T program because of the increasing pressures from Program Offices for more attention to problem-driven research.

RSAC's review of the President's budget found ample evidence that the need to balance core and problem-driven research is recognized by the Agency. During calendar year 2001, RSAC had the opportunity to review the content of two Multi-Year plans (*Review of the U.S. EPA Office of Research and Development's Water Quality and Pollution Prevention Multiyear Plans: An SAB Report EPA-SAB-RSAC-02-003*) for important research programs and received briefings on several Research Program plans. These activities reinforced the impression that the Agency is paying increasing attention to the necessary interplay between the two types of research activities. That being said, it is frequently difficult to draw a bright line in categorizing research projects into one category or the other. It is difficult to imagine good problem-driven research that does not contribute in some way to the development of basic scientific principles in environmental science and technology. Conversely, it is difficult to imagine the pursuit of problem-driven research without the construction of concepts and development of capabilities that come out of a core research program. Therefore, RSAC strongly recommends that the Agency be vigilant in defining and maintaining core research needed to achieve a balanced S&T research program.

Overall, RSAC is pleased with the Agency's continued attention to the planning of both its core and problem-driven research programs. However, the Committee offers the following observations.

Despite the lack of distinct boundaries between problem-driven and core research, RSAC believes that the overviews in the "Summary of the 2003 Budget" could have provided a clearer distinction between the two types of effort. In some instances, as identified above, the problem-driven research appears to be of a more fundamental character than research areas described under Goal 8. In other descriptions it is difficult to distinguish between the research identified in the program goals and that under the Sound Science goal. Examples where the distinctions are not clear include descriptions of ecosystem research under Goal 2 and Goal 8. As written, these sections seem to suggest that developing the baseline information characterizing aquatic ecosystems would be developed under Goal 8, whereas the measures and indicators of ecological trends are under Goal 2. This could lead some readers to the conclusion that the Agency has confused core and problem-oriented research. However, the presentations by the Agency of the Water Quality Multi-Year plan made it clear that developing the baselines in different regions are indeed the fundamental step that must be taken for the program office to understand trends.

It is also clear that the Agency is making progress in describing the decisions it needs to make and the science needed to inform Agency decisions. However, insufficient information was provided to allow RSAC to evaluate whether the President's budget request is adequate to support the research needed to satisfactorily inform the current and future decisions EPA will be required to make. An example of this issue is the following. The problem-driven research efforts identified in the Clean Air, Clean and Safe Water, and Safe Foods program goals were not identified in the highlights or in the annual performance goals. This was in sharp contrast to the relatively straight forward performance goals state under Goal 8 (Sound Science). This could suggest to the reader of the 2003 Budget Summary that science and research are either not important to these programs or that ORD has not committed to performance measures. However, the Committee was satisfied from the presentations that neither of these were the case, but has concerns about the impression this leaves as to how science is valued within the Agency.

In addition, EPA does not have an apparent core research program in some areas where a strong argument could be made that it should develop core capabilities. For instance, the FY 2003 proposed budget also contains two modest proposals to enhance the Agency's capabilities in Biotechnology Research and Computational Toxicology. The RSAC endorses the new attention placed on these areas. However, it appeared that sizeable portions of these small programs were to be extramural. As described, the Computational Toxicology area would include new tools in molecular biology and bioinformatic approaches to toxicology as well as the older forms of Computational Toxicology, such as structure-activity relationships. These approaches will become fundamental for identifying individuals in the population that could be more susceptible to environmental stressors. These new tools should provide the opportunity to expand the Agency's research on susceptible populations well beyond the simple categorization schemes (i.e. children's health, women's health) on which the Agency now depends. There is

much interest in such approaches within the regulated community and such approaches could necessarily become an important part of the Program Office activities within a 5-10 year time frame. Because of the transformational influence that these advances can have for the Agency's regulatory programs, the RSAC is of the opinion that most of these resources should be devoted to the development of in-house capabilities. While RSAC is supportive of identifying areas of research for the extramural programs, we are concerned that this area will be critical to the Agency's mission in the relatively near term.

2.4 Focus of Research on Strategic Objectives and Unmet Needs

Charge Question: Is the EPA research and development program addressing the important issues needed to meet EPA's strategic objectives and protect human health and the environment in the US and globally? What important issues are not receiving adequate attention at the requested level of resources provided for the R&D program and the S&T budget?

In general RSAC is of the opinion that the EPA ORD research program addresses most of the important issues needed to meet EPA's strategic objectives. RSAC members commend EPA for its attention to organizing the S&T information within the structure of the ten EPA goals. This organization of information facilitates the analysis of the S&T efforts across offices and also highlights the coordination among the offices. The RSAC agreed that budget and program details were more easily understood in this structure than occurred with formats used in previous years.

RSAC members encourage program staff to continue these efforts to articulate how investments in S&T contribute to the EPA strategic plan. Along these lines, the RSAC recommends that in future presentations and descriptions of the budget request, EPA staff focus on a clearer delineation of the major S&T priorities in each office and explicitly link these priorities to goals and budget levels. In a number of cases, neither the written materials nor the presentations made these links explicit. These links are important to assess whether or not the investments are addressing important issues at appropriate dollar and staffing levels. Appendix A describes a number of examples where this was problematic.

On the question of issues that may not be receiving adequate attention, RSAC members identified two types of concerns. The first concern arose from cases where worthy research priorities were identified by the EPA staff in their presentations, but information about funding or staffing levels appeared inconsistent with a meaningful commitment to the research. For example, the presentation of the Office of Air and Radiation indicated that the impact of indoor air on asthma was a science priority. Research to address this priority was not explicitly stated as a key program. Apparently, this research is funded under "indoor environments." RSAC members found that the level of funding in this area, which appears to be flat relative to last year, may not be sufficient to give the issue the attention it needs. While it is obvious that EPA certainly cannot undertake a major scientific program that would encompass all possible areas of research in asthma, and since many other agencies are already involved in extensive research

endeavors to curtail this disease, EPA needs to articulate clearly the unique role its research plays in the important environmental aspects of the disease. The budget and research aims discussion should then identify the methods and steps EPA will take to bring their scientific work to the table in cooperation and partnership with other agencies to control this disease. Similarly, ORD's biotechnology and National Environmental Technology Competition did not appear at this point to have clearly defined objectives or scope. Based upon the information presented to the committee, these priority investment areas did not seem well developed.

RSAC also noted that when a legislative mandate is absent, "orphan" risks (even when known) remain unattended in the budgeting process. As we have noted in the past, the estimated health risks from hazardous constituents in indoor air are widely judged by scientists working in this arena to be greater than those posed by emissions from point, area, and mobile sources. Yet research to reduce residual uncertainties and risks from indoor air, or to devise intervention strategies in this area, is not well-funded in comparison to the more traditional regulated sources of airborne hazards. While EPA has no statutory authority to regulate indoor air quality, research in this area is necessary to achieve the ultimate goal of reducing exposures to airborne contaminants and the associated health risks.

These are symptoms of a broader problem that is reflected in other areas. EPA scientific and technology (S&T) efforts obviously need to focus on issues required by the current legislation and regulations. It is equally obvious that the EPA S&T efforts, both in ORD and the specific programs, need to focus on other important environmental issues that are affecting or could affect human health and the environment. Just as there needs to be a proper balance between problem-driven and core research in EPA, so too should there be an appropriate mix of S&T and research programs that address regulatory-driven issues and non-regulatory issues.

RSAC notes that the major focus of the EPA S&T, including ORD, research is on regulatory-driven research.

Therefore, RSAC recommends that EPA:

- a) identify specific non-regulatory driven issues of high importance to protecting human health, the environment, and ecosystems and
- b) in the next budget (FY 2004) request adequate S&T funds to address approaches to mitigate such risks.

In addition, RSAC urges Congress to seriously consider such budget requests and to provide needed budget, personnel and (if needed) legislation to allow EPA to address such risks.

The second type of concern regarding adequate attention focused on areas which either have been removed from the budget or do not seem to be considered sufficiently as priority areas. Specific research or investment areas in this category are:

- a) Climate change research. RSAC applauds the Agency on its Global Climate Research program. The committee was concerned, however, that climate change research is an area that demands more EPA involvement. The committee did not find that the presentations and materials addressed innovations or new investments in this area. For example, the committee did not understand why EPA has not been included in the Climate Change Research Initiative (CCRI) efforts.
- b) Pathogens. The summaries of the goals that drive the EPA funding have identified many important areas in which the Agency should invest science dollars and expertise. However, it is often difficult to be sure that the emphasis and funding for these activities are adequate. Some funding must be directed to the area but it is not clear that the balance is adequate. For example, pathogens and biological agents are important contaminants of drinking water, recreational waters, ecological systems and food supplies. Changes in potential pathogens using different disinfection practices or in the presence of stressors in waterways are likely areas of research. Only the research agenda under the safe drinking water goal includes a discussion of the importance of microbes under the Candidate Contaminant List (CCL). The focus of the discussion was on monitoring, measures of outcome in humans and treatment technologies. The documents do not provide a clear picture of how much of the science budget in several area goals where these contaminants are important is devoted to basic research on pathogens.
- c) Risk Communication. RSAC is supportive of ORD's framework for program evaluation. Committee members noted, however, that program success was often dependent on appropriate and effective risk communication. Despite the plans to apply risk communication, there was no indication in the presentations or written materials of any investments in the science supporting effective risk communication outside of the grant process.
- d) Decision making research. RSAC also supported the investments to increase the science to support regulatory decisions. RSAC agrees that adding personnel to address key issues in the regulatory development process is a worthwhile investment. These investments, however, appear targeted to the internal EPA decision making process and do not address any investments in the science of decision making. ORD should consider that enhancing the links between science and decision making is also a process capable of being improved by sound research.
- e) Sediments. Sediments are an important component of the EPA's research program. The Committee has identified two areas that appear to have insufficient resources or are not a clear focus of the Agency programs. These areas deal with sediment assessment of contaminants and improving water quality criteria through development of bioavailability models and assessment of dietary exposure. In

brief, the Agency has developed sediment assessment guidelines for some metals (sulfide binding to AVS) and for non-polar organic substances (equilibrium partitioning), but has not addressed other classes of substances, low sulfide and low carbon environments, or high energy systems where equilibrium conditions do not exist. Nor has the Agency developed an overall integrated (chemical and biological) approach for assessing contaminated sediments. While the Agency has indicated that a Sediment Plan has been developed, it is not clear that it covers all the issues described above and the committee questions whether \$0.7M is an adequate level of funding. For example, the Agency has recognized for some time that there is a need to incorporate dietary exposure into its water quality criteria approach (for substances with high binding affinity). This is a major gap in the existing approach and there does not appear to be a program focused on this topic. An area of increasing interest is the potential for contaminated suspended solids to be an important pathway for dietary uptake by bivalves and mollusks.

- g) Clean and Safe water. The extent to which funding is provided for the following three important research areas is not clear to the Committee
- 1) nutrient impacts and means to establishing mitigation and water quality criteria (RSAC acknowledges on-going research at the Agency, for instance at EPA's Mid-Continent Ecology Division in Duluth, Minnesota but the extent of the work was not made clear to the Committee)
 - 2) risk of infectious diseases resulting from both microbial and viral exposure, not just for humans, but for aquatic life as well
 - 3) impacts of suspended solids upon aquatic life both from the view point of physical damage, but also due to chemical contaminants carried with suspended solids.
- h) Drinking Water from Impaired Sources. Drinking water standards are developed with the explicit assumption of an acceptable source. For this reason drinking water standards have not been regarded as sufficiently protective when drinking water is drawn from sources heavily impacted by intensive agricultural practices or municipal wastewater (NRC, 1998, "Issues in Potable Reuse: The viability of augmenting drinking water supplies with reclaimed water". National Academy Press, Washington, DC. pp. 17-20 and 31-43). In part, this is because important contaminants in these sources often do not conform to expectations and can range from novel precursors of disinfection by-products to hormonally active compounds and pharmaceuticals. As source water shortages will impact the water supplies of the nation, it is becoming increasingly important to identify what is an acceptable water supply and what mitigation strategies are necessary to make impaired waters suitable for drinking water.

2.5 Focus on Environmental Outcomes

Charge Question: How can EPA better use measures of performance that focus on environmental outcomes to identify the impact of its research and development program and the funds that Congress provides for that Program?

It is a challenge to answer this question other than in a very general way. The ability to quantify and effectively communicate the impact of EPA's research has been difficult because of the lack of clearly defined outcomes that could be used to monitor progress towards the attainment of program goals, as well as to measure the impact of research activities at EPA. During the presentations, ORD described a logical framework for developing outcome measures. The approach is consistent with earlier discussions during previous RSAC reviews, and the Committee would like to contribute to and assist EPA through consultation or other suitable venues as it proceeds to further develop outcome measures within the proposed framework.

In order for RSAC to provide advice as to how to improve the existing measures of performance, the Agency needs to present the supporting technical materials that lead to the derivation of specific Annual Performance Goals. For example, listed outcomes include "reduce energy consumption by 95 billion kilowatt hours, restrict domestic consumption of class II HCFCs below 9,960 ODP-weighted metric tonnes, complete 22,500 LUST cleanups", etc. It is not clear that these goals have any technical basis nor are they specifically related to any Agency research and development program. Lacking clear justification for selected Annual Performance Goals, the identified performance measures might be trivial or entirely infeasible in relation to funds provided by Congress.

A second step towards better use of measures of performance lies in determining which outcomes or what percentage of specific outcomes are influenced by activities outside the Agency and its R&D programs. In other words, if desired outcomes are measured, how is it determined that Agency activities were the primary causal mechanism? Finally, for outcomes that derive solely from Agency activities, relationships must be established between the magnitude of funding and the degree of performance as evidenced by environmental outcomes. Such relationships, while likely uncertain, may indicate funding thresholds necessary for any measurable performance, as well as funding amounts that result in diminishing returns on R&D investments.

It could be possible and useful to include economic and social dimensions in this framework to assist in the decision making processes. RSAC is interesting in hearing about relevant economic and social science research at a future EPA presentation.

2.6 Other Comments

Recent years have seen the Agency assigned ever more responsibilities. This has also been accompanied by calls to increase the extent to which Agency action is based on "sound science". The only way in which it will be possible to meet the expanded responsibilities, while continuing to assure the quality of the science used, is for the S&T budget to be maintained and

increased over time. The Committee urges the Agency to clearly explain this need to the OMB and to Congress.

Further, RSAC encourages EPA to maintain and increase the investment in research needed to meet the needs of the Agency. This is particularly important in emerging scientific areas such as genomics, proteomics and bioinformatics. RSAC continues to recommend that the Agency be vigilant in defining and maintaining the core research needed to achieve a balanced S&T research program.

The ORD S&T budget request for FY 2003 did not include funds for Congressionally directed add-on (so-called earmarked) projects. RSAC commends Congress for providing additional funding to support these directed activities in the FY 2002 budget and strongly recommends that Congress continue to appropriate the additional funds needed for the successful completion of the projects or programs it adds on to the S&T program budget. This Congressional action will minimize impacts on the already scarce S&T budget for EPA.

To identify its core and problem-driven research priorities and projects, ORD has undertaken a careful research planning process in coordination with the Agency's Program Offices. RSAC believes that both the S&T budget, including the ORD budget, is the result of a sound and appropriate prioritization of Agency needs and distribution of resource levels at the allocated resource levels. If additional programs or projects are added to ORD by Congress without the appropriate additional funds, it is not likely that ORD will be able to accomplish its identified goals and objectives.

2.7 Continuing Issues

In addition to the five specific charge questions, RSAC was asked to address additional questions in this review and in subsequent RSAC meetings. The following provide comments from RSAC related to these additional questions. This was not specifically discussed with the Agency during the budget review. The responses result from the RSAC members experiences with EPA and from the RSAC review of the FY 2003 S&T budget request for EPA.

- a) *How does EPA capture and use scientific knowledge generated by other organizations in its multi-year planning efforts for the EPA research and development program?*

Based on several internal documents and associated presentations made by Agency personnel to various committees of the SAB, the Agency has developed elaborate mechanisms nested in many of its program offices for planning and implementing research programs. For example, external peer review, particularly when incorporated early in the development of a program, constitutes a venue for incorporating knowledge developed elsewhere. Usually, the criteria for selecting specific topics are those that relate directly to regulatory expedencies, congressional /judicial mandates, specific elements of Agency strategic plans, and resource constraints. Although it is recognized that great benefits can be derived from more extensive use of knowledge (approaches, methodologies and data) generated by other organizations, it is not evident that a systematic approach has been developed to achieve this. Joint funding of research

projects with other agencies such as the National Science Foundation and the US Geological Surveys should be encouraged but such programs do not go far enough, with respect to analysis and use of data from external research-performing organizations. While peer review by external scientists is a necessary process for evaluation of Agency approaches to problem characterization and mitigation, it is not a substitute for the creation of a mechanism for continuous adaptation of state-of-the-art information from external entities, into agency research programs. This is necessary because most of the issues that the Agency is tackling are too large to be effectively treated within the constraints of the Agency's intellectual and material resources.

One issue that may arise with respect to use of external scientific information is bias. Some may argue that information supplied by industries or environmental organizations is too skewed to serve public interest. There is also some concern in the scientific community that the universe of publications on a issue may be biased towards research that shows or implies positive associations between stressors and outcomes, reflecting a resistance among journals and their reviewers to publish negative findings. A transparent process of evaluation can minimize the ravages of such biases if they are present. Some of the tools and mechanisms that the agency can use to capture and use scientific knowledge generated by other organizations are briefly outlined below:

- i) Sponsorship of state-of-the-science reviews of issues associated with its program plans within each of the strategic goals to better refine and focus its efforts on uncovered issues.
- ii) Development of regular forums with other federal agencies, industrial research institutes and science/policy focused environmental groups to solicit for data for input into its internal research planning and implementation programs.

b) To what extent is there adequate peer review of the science available for policy and regulatory decisions at EPA, particularly peer review of the planning for the R and D program and of the products from the R and D program?

The Agency has many mechanisms for peer review. A recent presentation made by Agency officials to the Executive Committee of the SAB indicates that there are at least twenty external advisory organizations to the Agency, of which the SAB is one. The Agency also produces hundreds of documents that describe methodologies, regulatory approaches, data, etc, each year. These products, some of which support policy and regulatory decisions, have various levels of scientific content.

RSAC is aware that the Agency has developed peer review rules, approaches and procedures in its Science Policy Council Handbook of Peer Review (EPA100-B-98-001), which was reviewed by RSAC in September 1999 ("An SAB Report: Review of the Peer Review Program of the Environmental Protection Agency", EPA-SAB-RSAC-00-002), and the application of this guidance to specific products in June 2001 ("Implementation of the Environmental Protection Agency's Peer Review Program: An SAB Evaluation of Three

Reviews”, EPA-SAB-RSAC-01-009) . Appropriately, with respect to decision-making by the Agency, the policy “requires peer review of the basis for the decision (i.e., underlying major scientific and/or technical work products), not the decision itself.” Thus it should always be recognized that adequate scientific peer review can lead to, but not guarantee a solely scientifically-based decision because decision makers do not necessarily base their decisions only on scientific facts. However, the basis for decision making, including all scientific and non-scientific considerations, should be clearly delineated by the decision maker.

With this understanding, it is fair to state that the Agency has developed a systematic process for scientific peer review of its products. Agency program officers, who are involved in science and technology-related projects should be continuously aware of the definitions and protocols that are described in the peer-review guidance. Particularly, the definition of an independent peer-reviewer is very important. On page 21 of EPA 100-B-98-001, it is stated “ An independent peer reviewer is an expert who was not associated with the generation of the specific work product either directly by substantial contribution to its development or indirectly, by significant consultations during the development of the specific product. In conclusion, the Agency’s science and technology peer review process, especially of its products, is reasonably good. Unfortunately, stakeholders may not always differentiate between the soundness of the science that went into decision-making, amidst other factors, and the concerns with the decisions made. Frequently, such decisions have both merits and demerits because of the compromises necessary to strike a balance among many competing issues and factors.

c) *What is the assessment of the committee (RSAC) of the quality of the science being done at EPA, particularly that supported by the S and T budget?*

The Agency’s leadership mandate on each of its eight strategic goals implies that it has to be at the fore-front of efforts to develop and/or adapt techniques, information and measures to identify, characterize and mitigate new and/or persistent risks to human health and the environment. Undoubtedly, the Agency has made and documented many high-quality accomplishments in science and technology. Many cycles of SAB review of models and research data produced by EPA laboratories, often in collaboration with academic institutions, indicate that the scientific quality of most of its products is high. Often, related issues are covered by other Agencies with larger resources on those issues. For example, the Centers for Disease Control and the National Institutes for Health are likely to treat environmental-related health issues more extensively and intensively than the EPA but the EPA can not avoid involvement in complementary research, even in those sectors because it needs core competencies of its own to effectively implement its programs.

In recent years, the Agency has achieved significant accomplishments in research and development. As documented in the report: Research Accomplishments-Fiscal Years 1997-1998 (EPA 600-R-99-106), among these accomplishments are development of advanced methods of environmental monitoring using satellite imagery and ground-based ecological measurements; evaluation of chemical interference with endocrine systems of animals; creation of computer-based models of long-range transport of air pollutants; and development of improved methods of contaminant detection in drinking water. The Agency needs to increase the publication of its

research and development work in external peer-reviewed/refereed journals. This is a key factor in gaining recognition of the integrity and excellence of its science and scientists.

APPENDIX A –ACRONYMS

CCL	Candidate Contaminant List
EMAP	Environmental Monitoring and Assessment Program
EPA	US Environmental Protection Agency
FY	Fiscal Year
GPRA	Government Performance and Results Act
NAS	National Academy of Sciences
OPPTS	Office of Pollution Prevention, Pesticides and Toxic Substances
ORD	Office of Research and Development
RSAC	Research Strategies Advisory Committee
SAB	Science Advisory Board
S&T	Science and Technology

APPENDIX B - BUDGET OBSERVATIONS

The following provides detailed comments and observations of RSAC as a result of its evaluation.

The major goal that utilizes the majority of research monies in the appropriation is Goal 8 – Sound Science. Of the total Science and Technology budget request listed for the Agency, \$670,008.0* , the total budget for the Goal 8 area is \$327,837.6 (48.9% of total S & T budget) with \$254,607.9 or 77.7% of the budget allocation for this goal appropriated to research, science and technology. Therefore, this area will require the greatest scrutiny. However, other areas also have S & T line item budgets under the “FY 2003 Animal Performance Plan and Congressional Justification”.

The “Summary” document and the “Justification” budget do not always agree on the dollar amounts for research or even whether there are appropriations for research. For example, the “Justification” document has S & T funds listed under every goal but the “Summary” document has no S & T funds allocated for research under Goals 9, “Deterrent to Pollution” and 10, “Effective Management”. In fact, for these 2 goals no information is given on research in the documentation so it is difficult to determine the appropriateness of the funding amounts. For all other goals, there is a S & T appropriation in the “Justification” document and some indication of research or science activities funding in the “Summary” document budget. However, the monies identified in the “Summary” are always lower than in the “Justification”. Thus, there must be several areas in each goal that are thought to receive S & T funds but they are not specified.

For each goal other than 9 & 10, the “Summary” document provides some indication of the areas of research to be undertaken with science funds. In order to evaluate whether the S&T funds provide coverage for these areas, the review examined the research objectives listed to evaluate them against needs and itemized funding budget. These are discussed by goal.

Goal 8 – Sound Science

Major research areas in this goal include assessing the baseline condition of ecosystems in order to assess potential changes.

- a) Assessing environmental impacts on susceptible subpopulations, especially children.
- b) Combined effects on human health and ecosystems, especially endocrine disruptors.
- c) Holistic approach to combined stressors.
- d) Research into principles governing sustainable systems.
- e) Evaluate costs of technology.

* Note: Funds in thousands.

f) Evaluate effectiveness of technologies.

Part of ecosystem research includes refinement of the EMAP approach to large rivers. EPA proposes new research into risks of children from exposure in school and daytime environments. The Agency will develop new research to address temporal variation in exposures and its effects, relative toxicity of mixtures, development of biological markers of exposure, effects and susceptibility, and use of mode of action to assess cumulative risk. There is an emphasis on improving use of science in environmental decision-making. The discussion includes many references to endocrine disrupting chemicals (EDCs) and mercury as well as persistent bioaccumulative toxics (PBTs) and VOCs.

To these ends, the budget reflects increases in almost every area of research. The main support is for ecosystems, EDCs, and Pollution Prevention. The overall budget reflects a reduction of \$8,229.0 from the FY 2002 enacted budget, but there are more work years and these targeted areas of research have not been decreased. The major differences are no funds appropriated for the "Common Sense Initiative" and the "Congressional Projects" as well as the STAR fellowship program. The last area may be the most unfortunate loss since educational training money is difficult to obtain especially for environmental work. We need to train the new thinkers for the future.

The funds listed under goal 8 are \$327,837.6 which is down \$8,229.0 from the previous years. The areas of research noted in the "Summary" document total \$209,607.9. The areas with very little funding are research to support FQPA perhaps because there are adequate funds in "Safe Food". There is also no direct mention of Arsenic research which is a main focus of the "Clean Water" goal. Again funding may be elsewhere. There is no discussion of any research to support "Clean Air" initiatives.

Goal 1 – Clean Air.

The total funding for this goal is \$ 597,977.3 with an increase of \$4,615.5 from last year. The research budget identifies three major areas, air toxics, particulate matters and tropospheric ozone. The total monies in these areas is \$93,303.8 but the "Justification" reads \$174,662.0. It would be helpful to determine where the additional \$80,000.0 in funds occurs. All of the target research areas have had increases in funds.

The research focus areas discussed in the chapter for this goal follow closely the funding categories in the "Summary of the 2003 Budget". The NAAQS related research will assess health from the six air pollutants above and in combination with an emphasis on PM and ozone. The air toxics research focuses on urban environments and human health. The main source for these contaminants is mobile sources. The Agency mentions frequently an effort to determine risks from combined or multiple risks. CO, lead, ozone, nitrogen oxides and sulfur dioxide are mentioned under funded areas but research is not mentioned. No Congressionally mandated projects are listed for funding.

The areas of funding appear to cover the needed research topics given that the specific air pollutants listed as CO probably represent funded science as well as other activities as risk assessment in these areas. There seem to be no areas that have been missed.

Goal 2 – Clean Water.

The total budget for this goal is \$3,214,674.2 which is \$524,316.1 less than last year. In the list of “Summary” budget items designating research, the funds are \$93,580.5 which is less than the \$113,319.6 in the “Justification” list. The listed research areas include ecosystems condition, recreational waters and wet weather flows and safe drinking water. The other areas that may have some research components are specific water bodies as well as fish contamination consumption and wastewater management. However, it is not possible to know how much is in each area.

The research areas in this goal include:

- a) Filling in gaps on risk information and dose response for DBPs, arsenic, pathogens and other materials on the Contaminant Candidate List (CCL)
- b) Support of protection and enhancement of aquatic ecosystems and their biotic components
- c) Develop biological and landscape indicators of ecosystem condition, sources of impairment and stressor response/fate and transport models.
- d) Develop framework for diagnosing adverse effects of chemicals on surface waters
- e) Develop cost-effective technologies to manage solids and sediments
- f) Develop and validate effective watershed management strategies and tools for controlling wet weather flows (WWFs)
- g) Arsenic-specific research and cost effective technologies for removal
- h) Risk of infectious disease from microbes in recreational waters.

Some of these areas of research are not clearly identified in the budget, such as arsenic research. Others apparently fall under areas such as “Safe Recreational Waters” and “Watershed Assistance”. However, it is unclear whether these areas cover research in the area under the research aims for Goal 2. Since these research topics are significant, it would be important to be sure funds are adequate.

The areas of importance such as environmental risks are clearly listed in the document. However, the budget does not indicate what weight they will be given in terms of funding. For example biologic materials, both pathogens and others, are some of the most important agents in terms of both human and ecologic impacts. These agents are being recognized more and more as

environmental issues, especially with potential changes in disinfection and changing contamination of waterways. The budget does not provide any information on how much will be spent on these issues compared to chemical contamination.

The loss in budgeted funds from the FY 2002 enacted budget to the FY 2003 President's Budget Request reflects in part an omission of Congressional projects. Thus, most of the areas except "Recreational Waters" have actually increased slightly.

Goal 3 – Safe Food.

The budget for this goal is \$109,814.6 which represents an increase of \$742.9 from the amount of 2002. The total science budget as indicated in the "Summary" document is listed as "Research to Support FQPA" at an amount of \$10,821.3 which is lower than the S & T listed in "Justification" document of \$14,3716.

Research under this goal includes:

- a) development of pesticide exposure and effects data
- b) risk assessment methods and models for children
- c) development of control technologies to comply with FQPA

The exposure and effects data include the identification of exposure routes and development of theoretical models for pesticides and other toxic substances.

The environmental problems associated with safe food and the research aims and funding do not match well. The Agency has discussed the importance of bioengineered species but the budget does not reflect research in this area. Mention is made of insuring the safety of this biotechnology but the method of testing is "peer review". The focus is totally on chemical pesticides as they are applied. Do other issues such as infected food/feed or changes in chemicals through processing etc. all fall into someone else's dominion? Are there no "Homeland Security" issues in "Safe Food" that fall to the EPA to monitor? That budget was cut entirely.

The overall budget for this goal increased but the overall budget for S&T decreased slightly. The major area phased out was "Safe Pesticide Applications". The question arises whether there is any research monies in "Science Coordination and Policy" for this issue. There could be some funds in the "Endocrine Disruptor Screening Program" but this would not be effects-based research.

Goal 4 – Preventing Pollution

The budget for this goal is \$326,651.9 up \$6,736.8 from 2002. In the "Justification" document, the S&T budget is listed as \$27,843.6 which represents an increase of about 3 million from last year. However, when one tries to match this estimate with targeted research as listed in the "Summary" document, this is very difficult. There is one topic area listed as "Research to

Support Safe Communities” at \$ 25,149.6 which would include most of the funds listed in the Justification document. As in the goal 3, there is a heading “Endocrine Disruptor Screening Program” that might have a research component. The major question which arises is why this activity appears in funding for both Goals 3 and 4 and what is the difference in focus, if any? Is this simply joint funding of a single effort?

The research areas in this goal include:

- a) providing a framework for developing an integrated suite of tools and models to assess risks to human health and ecological systems from commercial chemicals, microorganisms, and genetically modified organisms
- b) develop mechanistically-based predictive models for human health risk assessment
- c) develop methods to evaluate effects with variety of exposures and sensitive subpopulations
- d) participate in Agriculture Health Study
- e) starting major research effort focused on biotechnology such as allergenicity, adverse ecological effects on non-target species or unintended gene transfer, and potential development of pesticide resistance in target species.

The goal addresses indoor environments, both in general and in children, that did not appear as a focus in other areas. There are two items in the budget addressing these areas but it is not clear what the research objectives will be in these areas. The discussion suggests that they will focus on asthma and target schools and health professionals. Are the suggested programs being subject to research and evaluation since they seem to target other organizations as health professionals that may not need education? How do they evaluate the deficits in the various indoor environments of these children especially since onset often occurs at preschool age? Are these research within the “Indoor Environment” funds?

Goal 5 Waste Management

The budget for this goal is \$1,711,279.8 that is an increase of \$190,596.0 in budget from that of 2002. The “Justification” budget indicates that only \$15,480.0 is designated under S&T. This amount represents a drop of \$42,563.8. If research is a major part of the activity related to this goal, this abrupt decline would suggest that several programs or areas in S&T activities have been dropped. However, the “Summary” budget indicates several areas that include “research” at least as part of their line title. These include “Hazardous Substance Research: Superfund Innovative Technology Evaluation”, “Hazardous Waste Research” and “Research to Support Contaminated Sites”. The total funds in these areas is \$44,214 with two out of the three receiving small increases and the last a small decrease. There should also be research going on at the “Hazardous Substance Research Centers” fund at \$ 4,599.2. It is unclear why there is a \$9 million differences between the two research budget listings.

Research efforts described for this goal include:

- a) reduce risks for human health and the environment by implementing scientifically defensible and cost-effective clean-ups of complex sites. The science will include improved models for measuring exposures and risks related to complex mixtures and multiple pathways, development of better technologies for clean up and determining extent of efforts on environment.
- b) begin a focus on clean up of buildings in relation to bioterrorism
- c) focus on waste identification to identify areas of risk and target the accumulation of information to support risk-based exemptions for waste and waste streams that do not pose risk.
- d) focus on waste management
- e) focus on waste combustion
- f) reduce uncertainties in sampling
- g) reduce time and cost for site characterization
- h) evaluate risks to humans and ecosystems based on multipathway exposure, potential adsorption of contaminants and treatment residuals.

The research objectives also suggest that some of the \$86,310.4 for “Homeland Security” will be focused on research in addition to those noted above. However, it is hard to resolve the items with the reported budget justification. The funding areas overlap the research items and the level of funding is probably about the same as it has been in the past.

Goal 6 – Global Environmental Risk

The budget for this goal is \$269,727.2 which is \$6,860.8 less than in 2002 with a loss of 13.0 work years.

The “Summary” budget reflects only one designated research category “Climate Change Research” with a budget request of \$21,729.3. However, the “Justification” budget shows a funding level for S&T of almost twice that much, \$38,848.6. In this case, as in the other goals, there is no obvious category to explain the discrepancy. The only major changes in the budget are that the Great Lakes National Office is phased out and Persistent Organic Pollutants (POPs) implementation is phased in.

The research for this goal includes:

- a) reducing greenhouse gas emissions through science-based solutions to reduce risks from climate change

- b) determine vulnerability of humans and ecosystems to environmental stressors as climate and land use changes
- c) continue UV monitoring network
- d) look specifically at air and water quality from climate change

The research objectives and the monies focused on Climate Change are clearly an alignment of funds and efforts. However, other topic areas would appear to warrant some research funding, such as “Global Toxics” or “POPS”. Are there research funds in these line items? The objectives under “Great Lakes” indicates that the National Program Office will work with states and Tribal and Federal Agencies to implement the Great Lakes Strategy, but that program is not obvious in the 2003 budget.

Goal 7 – Quality Environmental Information

The budget allowance for this area is \$199,124.0 up from the year 2002. The summary budget indicates no research but the “Justification” budget shows \$9,367.5 under S&T. RSAC had no additional comments on this Goal.

Goal 8 – Sound Science

The comments for this goal are found in the first section of this Appendix.

APPENDIX C – BIOSKETCHES

Dr. Raymond C. Loehr, Chair, Research Strategies Advisory Committee, is a licensed professional engineer in Texas, Ohio and Kansas and is currently the Hussein M. Alharthy Centennial Chair in the Environmental and Water Resources Engineering Program at the University of Texas at Austin. He obtained his B.S. and M.S. degrees from Case Institute of Technology and his Ph.D. from the University of Wisconsin-Madison. Prior to his current position, he has been a professor at the University of Kansas and at Cornell University. On separate academic leaves, he worked for the U.S. Environmental Protection Agency (EPA) in Washington and for a consulting firm. Dr. Loehr's expertise is in the use of land as a waste management alternative, the remediation of contaminated sites, soils and sludges, the treatment and disposal of industrial wastes and the practical application of research results. He has served as advisor to government agencies, industry, consulting engineering firms, and law firms on the use of waste management processes for environmental problems. He has over 300 technical publications related to municipal, industrial, and hazardous waste management and fourteen books authored or edited. Dr. Loehr was elected to the U.S. National Academy of Engineering in 1983. He has been chair and member of committees of the National Research Council (NRC), Department of Defense, and EPA. He Chaired the EPA Science Advisory Board (SAB) Executive Committee from 1988 to 1993

Dr. William J. Adams is currently the Director of Environmental Affairs for Kennecott Utah Copper Corporation. His areas of research interest focus on environmental risk assessment, ecotoxicology, hazard assessment of metals, and sediment assessment methodologies. He has published 65 papers in these areas and has authored several books and/or book chapters. Dr. Adams has served on the EPA Ecological Processes and Effects Science Advisory Board Committee for 8 years and on one or two other SAB subcommittees. Additionally, he has served on the National Marine Board committees reviewing sediment assessment. Additionally, he has served on numerous technical peer review committees and technical workshop committees. He received his B.S. in Biological Sciences (cum laude) in 1969 from the Lake Superior State University in Sault Ste Marie, MI. He received his M.S. in Wildlife Toxicology in 1971 from the Michigan State University, E. Lansing, MI and his Ph.D. in Aquatic Toxicology in 1976 from the Michigan State University in East Lansing, MI.

Dr. Steven M. Bartell is a Principal of the Cadmus Group, Inc. and an adjunct faculty member in the Department Ecology and Evolutionary Biology at the University of Tennessee. His professional interests include ecosystem analysis, ecological modeling, risk assessment, risk-based decision analysis, and sustainable environmental development. As a Principal in the Cadmus Group, his main responsibilities include marketing, project management, and personnel development. However, he also remains actively involved in the technical aspects of nearly all ongoing projects. Dr. Bartell continues to be actively involved in research and consulting projects that address various topics (e.g., nutrients, metals, habitat alteration). The Cadmus Group does a substantial amount of consulting work for the Agency, primarily in the Office of Water.

Dr. Richard J. Bull is presently employed one-half time as a Professor of Pharmacology and Toxicology at Washington State University (Tri-Cities Campus) and also work as a consultant in toxicology through a sole proprietorship company (MoBull Consulting). Dr. Bull has specialized in the toxicology of and risk assessment for chemicals commonly found in drinking water. He was employed by the Environmental Protection Agency in the period 1971-1984. His last position was as Director of the Toxicology and Microbiology Division of the Health Effects Research Laboratory in Cincinnati where he managed the Health Effects Research Programs under the Safe Drinking Water Act and under the Clean Water Act for the Agency. Personal research interests were in the effects of lead on brain development and the mutagenic and carcinogenic effects of disinfection by-products. In 1984 he accepted a position with Washington State University where he taught pharmacology and toxicology. His research in the toxicology and carcinogenicity of chemicals that were contaminants or additives to drinking water continued. In 1994, Dr. Bull accepted an appointment as Senior Scientist at Pacific Northwest National Laboratory (managed by Battelle) where he remained until May of 2000. His activities at Washington State University are supported by a grant from through the Department of Energy's Low Dose and Low Dose Rate Radiation Effects Program. Dr. Bull has also been involved in a variety of scientific reviews associated with specific environmental contaminants. In recent years, he chaired the NRC review of Copper in Drinking Water, the EPA SAB Drinking Water Committee's review of the Proposed Drinking Water Standard for arsenic and served on the Arsenic Rule Benefits subcommittee for the U.S. EPA's Science Advisory Board. He also serves on the Science Advisory Panel for the Santa Ana River Water Quality and Health Study in Orange County California and has worked with Orange County in seeking Federal Support for their research

activities directed at determining processes that are effective in allowing indirect potable reuse of wastewater.

Dr. Robin Cantor, is a Principal and Managing Director of LECG, LLC, a private consulting firm providing economic and financial analysis to a broad range of public and private enterprises. She also has a faculty appointment in the Part-time Program in Engineering of the Johns Hopkins University. She is currently the President for the Society for Risk Analysis. From 1991 to 1996, she was Program Director for Decision, Risk, and Management Sciences, a research program of the National Science Foundation. While at NSF, she was also a Coordinator for the NSF Human Dimensions of Global Change, the NSF Methods and Models for Integrated Assessment, and the NSF/EPA Decision Making and Valuation for Environmental Policy. From 1982 until 1991, she was a senior researcher at Oak Ridge National Laboratory. Dr. Cantor's areas of expertise include environmental and energy economics, statistics, risk management, public policy and societal decision making. She has conducted research in many issues related to environmental economics including analysis of Canadian and US nuclear policies, recycling and waste management economics, environmental externalities associated with different fuel cycles and energy technologies, private sector responses to global warming, electric power plant cost estimation and planning, auction behaviors and demand side management programs, possibilities for cost-sharing arrangements between local jurisdictions and other government agencies to clean up hazardous waste sites, social and individual valuations of non-marketed goods, and consumer and industrial product prices in the context of anti-trust and other complex litigation.

Dr. Hilary I. Inyang is the Duke Energy Distinguished Professor of Environmental Engineering and Science, Professor of Earth Science and Director of the Global Institute for Energy and Environmental Systems at the University of North Carolina-Charlotte. He holds a Ph.D. in geotechnical engineering and materials, with a minor in mineral resources, from Iowa State University. Prior to his current position, he was University Professor, Dupont Young Professor and Director of the Center for Environmental Engineering, Science and Technology (CEEST) at the University of Massachusetts, Lowell. His research and allied professional activities have focused on waste containment systems, contaminant leachability, soil / contaminant physico-chemical interactions, natural disaster mitigation techniques, rock fragmentation techniques for energy installations and underground space, and energy / environmental policy. His projects have been sponsored by federal agencies such as US. Department of Defense, U.S.

Environmental protection Agency, U.S. Department of Agriculture, National Oceanic and Atmospheric Administration, Federal Highway Administration and the United States Agency for International Development. He has authored / co-authored several research articles, book chapters, federal design manuals and the textbook- Geoenvironmental Engineering: principles and applications, published by Marcel Dekker. He is an associate editor / editorial board member of eight refereed international journals and contributing editor of three books, including the United Nations Encyclopedia of Life Support Systems (Environmental Monitoring Section). From 1997 to 2001, Dr. Inyang served as the chair of the Environmental Engineering Committee of EPA's Science Advisory Board. He is a member of the National Advisory Council on Environmental Policy and Technology (Effluent Guidelines Committee) and has served on more than sixty international, national and state science /engineering panels and committees. He is currently the elected president of the newly-formed International Society of Environmental Geotechnology and has co-chaired several international conferences in the US, Brazil, China, Canada and Japan since 1995. He holds Ph.D. in Geotechnical Engineering/Materials from Iowa State University; MS and BS in Civil Engineering from North Dakota State University and B.Sc. (honors) in geology from the University of Calabar, Nigeria. Dr. Inyang is a former AAAS/EPA Environmental Science and Engineering Fellow, National Research Council Young Investigator (1997) and Eisenhower Fellow of the World Affairs Council (1992/93).

Dr. Alan W. Maki received his BSc. in Fisheries Biology from the University of Massachusetts, his MSc. in Environmental Toxicology from the University of North Texas, and holds a Ph.D. in Wildlife and Fisheries Management from Michigan State University. He is currently Environmental Advisor for ExxonMobil Production Company and is responsible for providing advice and consultation concerning the environmental consequences of oil and gas exploration and production activities. He previously worked at ExxonMobil Biomedical Sciences in East Millstone, New Jersey and with the ExxonMobil Safety, Health and Environment Department in Houston, Texas. He served as Senior Environmental Scientist for Exxon in Alaska from 1985 to 1991 managing numerous environmental programs in the Prudhoe Bay oil field and along Alaska's North Slope. Following the Exxon Valdez oil spill, he was responsible for managing Exxon's wildlife rescue rehabilitation program and for organizing the company's scientific assessment of ecological damage and recovery. Dr. Maki has authored and co-authored over 250 publications and reports and 6 books on numerous aspects of environmental quality, ecological risk assessment, toxicology

and aquatic biology. Active in a wide range of professional organizations, Dr. Maki is currently a member of the Environmental Protection Agency - Science Advisory Board and has served on numerous advisory panels for EPA Office of Research and Development. He is former President of the Society of Environmental Toxicology and Chemistry, and has served on National Academy of Science panels concerned with the assessment and management of ecological risks and environmental issues in Western Europe.

Dr. Maria T. Morandi received a B.S. in Chemistry from the City College of New York, and M.S. and Ph.D. degrees in Environmental Health from New York University-Norton Nelson Institute of Environmental Medicine. She is certified in the practice of Industrial Hygiene by the American Board of Industrial Hygienists (ABIH). Dr. Morandi is an assistant professor of Environmental Sciences and Occupational Health at the School of Public Health of the University of Texas-Health Science Center in Houston, Texas. She has served in a number of SAB and other committees and review panels for the Environmental Protection Agency; the Safety and Health Study Section, Mine Safety and Health Research Advisory Committee and training grant review panels for the National Institute for Occupational Safety and Health (NIOSH), the Board of Scientific Counselors of the Agency for Toxic Substances and Disease Registry (ATSDR), and grant application review panels for the NIH. Dr. Morandi's teaching and research interests focus on assessment of exposures to airborne contaminants. She has performed work on laboratory development and evaluation of personal sampling methods for application in environmental and occupational settings, population-based field studies of indoor, outdoor and personal exposure to a broad range of airborne contaminants, population-based studies of the health effects of airborne pollutants, and in-vitro investigation of murine and human alveolar macrophage response to ozone and PM exposure. Her current research and teaching grant funding sources include the National Institute for Occupational Safety and Health (training grant), the Environmental Protection Agency (STAR grant), the M.L. Leland National Air Toxics Research Center (contract for an asthma panel study), and Research Triangle Institute (funded by EPA) for a contract on evaluation of low-cost passive dosimeters for intensive sampling of airborne volatile organic compounds.

Dr. Mark J. Utell is Professor of Medicine and Environmental Medicine at the University of Rochester Medical Center. He serves as the Director of the Pulmonary/Critical Care and Occupational/Environmental Medicine Divisions where he spends his time divided between patient care, research, teaching and

administration. He received his B.A. degree from Dartmouth College, his M.D. degree from Tufts University School of Medicine, received his residency training at St. Elizabeth's Hospital in Boston, and pulmonary training at the University of Rochester; he has been a member of the faculty at the University of Rochester Medical Center since 1977. Dr. Utell has served on a number of SAB committees and review panels for the Environmental Protection Agency and other agencies: currently, he serves as Chair, Health Effects Institute's Research Committee; and is a member of the National Research Council's Committee on Airborne Particulate Matter and the EPA's Search Committee for the Director, Human Studies Division. He has previously served on the Executive Committee of the EPA's SAB; as Chair, EPA Environmental Health Committee; member and consultant to CASAC; and as a member of the National Institutes Environmental Health Sciences Grant Review Study Section. As a member of the NRC's Committee on Particulate Matter, he has previously participated in the development of recommendations for EPA's research budget on particulate matter and these recommendations have been published. Dr. Utell's research and teaching interests have focused primarily on the effects of inhaled particles, fibers and vapors on the respiratory system. Most recently, his laboratory has focused on clinical responses to ultrafine particles and mechanisms of response. Dr. Utell has over 100 publications and numerous presentations at professional meetings around the world.

Dr. James E. Watson, Jr. is a Professor in the Department of Environmental Sciences and Engineering at the University of North Carolina. His principal research interests relate to environmental radioactivity and radioactive waste management. He has conducted numerous studies on radon, both indoors and in water. He is a past president of the Health Physics Society, the national radiation safety society, and a past chairman of the Radiological Health Section of the American Public Health Association. He was selected as a National Lecturer for Sigma Xi, and he has served on National Research Council committees studying radioactive waste disposal, on the Centers for Disease Control and Prevention's Advisory Committee for Energy-Related Epidemiologic Research, and as chairman of the Environmental Protection Agency's Radiation Advisory Committee. He served as chairman of the North Carolina Radiation Protection Commission and currently chairs the Commission's Committee on Low-Level Radioactive Waste Management. He received his undergraduate education in nuclear engineering at North Carolina State University. He holds a M.S. degree in Physics from North Carolina State University and a Ph.D. in Environmental Sciences and Engineering from the University of North Carolina.

Dr. Lauren Zeise is chief of Reproductive and Cancer Hazard Assessment within the California Environmental Protection Agency's Office of Environmental Health Hazard Assessment. She came to state service in 1988 and has served in that position since 1991. In that position she oversees a variety of the state's cancer, reproductive and ecological risk assessment activities. Her group evaluates and provides advice on cancer, reproductive and ecological risks posed by environmental contaminants, and develops policy guidance for conducting such assessments. The group also conducts scientific evaluations mandated by Proposition 65 and evaluates the risks from use of drugs, cosmetics, gasoline and other products. It is also developing the state's guidance on evaluating risks stemming from the exposure of the young to carcinogens. She chaired California's Comparative Risk Project Human Health Committee, and oversaw the external review of the State's risk assessment practices, policies and guidelines. She has authored over 200 reports on environmental health risks for the State of California. Dr. Zeise has been involved in the evaluation and review of a variety of risk assessment issues. She has served on various committees of the EPA's Science Advisory Board (SAB), National Institute of Medicine, National Research Council (NRC), National Toxicology Program's Board of Scientific Counselors, and the former Office of Technology Assessment. She served on the EPA Board of Scientific Counselor's subcommittee reviewing PM research. Currently she serves on the SAB Research Strategies Advisory Committee, NRC Committee on Air Quality Management in the United States, NRC Committee on Toxicology, NRC Committee on EPA Star Grants Program, IOM Committee on Assessment of Wartime Exposure to Herbicides in Vietnam, and EPA FQPA Science Review Board. She is a member and fellow of the Society of Risk Analysis and is on the editorial board for that society's journal. The National Cancer Institute Smoking and Tobacco Smoke Monograph *Health Effects of Environmental Tobacco Smoke* was conceived and developed under her editorial direction. She is coauthor of the recently released International Agency for Research on Cancer monograph *Quantitative Estimation and Prediction of Cancer Risk*. Her research has focused on cancer risk assessment methodology and applications. She received her doctorate from Harvard University in 1984.