UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON D.C. 20460

OFFICE OF THE ADMINISTRATOR
SCIENCE ADVISORY BOARD

May 23, 2005

EPA-SAB-05-009

The Honorable Stephen L. Johnson
Administrator
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW
Washington, DC 20460

Subject: Advisory on the Office of Research and Development's Contaminated Sites and RCRA Multi-Year Plans

Dear Administrator Johnson:

At the request of the Office of Research and Development (ORD), a panel of the Environmental Protection Agency's (EPA) Science Advisory Board (SAB) developed an advisory on the ORD's Contaminated Sites and RCRA Multi-Year Plans. These plans will be merged in their next revision. ORD is developing a suite of multi-year plans that will focus its research program on the highest priority issues and provide coordination for achieving long-term research goals. The EPA Board of Scientific Counselors and the SAB are reviewing a few plans each year.

In general, the Panel finds that the Contaminated Sites and RCRA Multi-Year Plans are programmatically and scientifically sound. We note in particular the remarkable coordination of the program's research with that of the relevant program offices and other institutions and are encouraged by the judicious use of leveraging opportunities to significantly stretch limited resources to meet more of the Agency's needs.

The Panel's report contains suggestions for developing a merged plan that clearly relates the research to the Agency's strategic goals and targets. By clearly linking research priorities and the Agency's strategic objectives with defined long-term goals, themes and work products, the Agency will be able to demonstrate the relevance, quality, and contribution of the individual research activities to meeting the Agency's mission within resource constraints.

The two multi-year plans respond admirably to the short-term needs of the regions and program offices, but lack a sufficient long-term research program focused on emerging environmental issues. Programmatic support for addressing emerging environmental issues is vital for ORD to continue to be a leader in environmental research and to provide science and technical information needed by regional and program office decision-makers. The Panel has identified a number of areas for the Agency to explore the possibility of resource reallocation as well as some emerging environmental issues for which reallocated resources may be directed. Because EPA research on emerging issues is an issue that applies to many research programs, the Science Advisory Board elected to address the appropriate balance between responding to short-term needs and addressing emerging issues in its upcoming *FY 2006 Science and Research Advisory Report.*

If the Agency accepts these recommendations and would like additional advice regarding specific long-term goals and associated annual performance goals and measures for a program addressing emerging longer-term issues, the Panel will make itself available.

Sincerely,

/signed/

Dr. Granger Morgan, Chair
EPA Science Advisory Board

/signed/

Dr. Michael J. McFarland, Chair
Environmental Engineering Committee
EPA Science Advisory Board

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Review of the Contaminated Sites and RCRA Multi-Year Plans

The EPA Office of Research and Development (ORD) has developed multi-year plans on selected topics to focus its research program on the highest priority issues and provide coordination for achieving long-term research goals. The Science Advisory Board (SAB) and the Board of Scientific Counselors (BOSC) are reviewing the multi-year plans. The review of the Contaminated Sites and Resource Conservation and Recovery Act (RCRA) Multi-Year Plans was conducted by a Panel formed from the SAB's Environmental Engineering Committee, a member of the SAB's Ecological Processes and Effects Committee, and a member of the Board of Scientific Counselors. The review was conducted using a face-to-face public meeting July 7-9 and four public conference call meetings. Those who would like to learn more about the Panel's deliberations in reaching this consensus may wish to read the minutes of the July 7-9 meeting.

The Contaminated Sites Multi-Year Plan describes ORD problem-solving research supporting three Office of Solid Waste and Emergency Response trust fund programs for which research is authorized. These trust funds are Superfund, Leaking Underground Storage Tank Corrective Action, and the Oil Spills Program.

Contaminated Sites research is aligned along four long-term goals: three of the goals based on the affected medium and one goal for cross-cutting issues:

- sediment;
- ground water;
- soil/land; and
- cross-cutting issues.

The RCRA Multi-Year Plan focuses primarily on:

- treatment processes for hard-to-treat chemicals;
- innovative containment technologies;
- resource conservation; and
- site-specific technical support and state-of-the-art methods, tools, and models for addressing priority RCRA management issues.

Before providing summary answers to the charge questions, the Panel would like to make some general observations and highlight certain important recommendations.

The plans were prepared by EPA staff from laboratories, headquarters, regional and program offices. This group effort clarified the research needs of the program and regional offices, organized and coordinated the research activities at the multiple EPA laboratories involved, and provided the organizations involved with a working relationship of mutual respect. The team approach evident in the preparation of these documents may be of even greater importance than the documents themselves. ORD and

OSWER jointly establish prioritiesT[1]. For reasons presented in 1e below (some of which are outside the Agency's control), priorities understandably emphasize meeting short-term, immediate needs of the program office. There is some overlap in the issues addressed in the two documents, and as a result the Agency intends to merge the Contaminated Sites and RCRA Multi-Year Plans.

Despite existing in a sea of change that makes portions of the multi-year plans obsolete almost as soon as they are written—for example, the ongoing change in the Agency's strategic goals—the documents are very useful and could be more useful yet. Most of the Panel's recommendations focus on improvements to the documents to better articulate the linkage between the goals of the research program and the work performed. The Panel supports ORD's plan to merge the documents into a single plan that clearly relates the research to the Agency's strategic goals and targets. By clearly linking research priorities and the Agency's strategic objectives with defined long-term goals, themes and work products, the Agency will be able to demonstrate the relevance, quality, and contribution of the individual research activities to meeting the Agency's mission within resource constraints. This linkage will further ensure and better document that projects are selected and resources are distributed consistently to meet agency goals.

Given the importance of the work already in the program, the Panel recommends that ORD establish a line item in its annual research budget that specifically supports research that looks far ahead (10+ years) on emerging needs, ideally through new resources, but by re-programming if necessary. This is primarily a matter of ensuring the institutional health of ORD as a research organization and for EPA as a leader in environmental research. Without this change, the program will not, five years from now, be able to provide the quality of work and assistance that it currently provides to the regional and program offices. The Panel has also identified some areas for the Agency in which to explore the possibility of resource reallocation as well as some emerging research areas for the Agency to consider.

1. What changes should be made to ensure that the long-term goals select and articulate the high priority science, engineering, and technology needs of the Agency to meet its strategic goal for preserving and restoring the land.

Charge question 1a -- "Do the multi-year plans provide logical frameworks for organizing the research programs?"

Together the Contaminated Sites and RCRA Multi-Year Plans provide a logical framework for organizing Agency-funded research. The long-term goals and subsidiary themes are appropriate based on: the *2003-2008 EPA Strategic Plan*; research needs

[1] One member of the Board wished to call the Agency's attention to the priority setting methodology used in the National Research Council's report entitled Confronting the Nation's Water Problems: The Role of Research (2004) which can be found at http://books.nap.edu/books/0309092582/html/index/html. Pages 10-12, 91-92, and 167-177 would be the most relevant in terms of establishing a uniform conceptual basis for setting priorities.

articulated by the Office of Solid Waste and Emergency Response; and the Panel's understanding natural and social science, engineering, and technology research needs relating to wastes. The annual performance goals, themes, and long-term goals relate to one another in an orderly way. Not all projects fit neatly into this structure and some annual performance measures could be improved. However, on the whole, these two multi-year plans succeed at organizing the research to meet the Agency's needs.

Since these multi-year plans were last revised, EPA revised its *Strategic Plan*, reorganizing its goals and reducing their number from ten to five. Some work in the current plans will be moved to other multi-year plans and some entirely new and relevant multi-year plans are in preparation. Every project must fit under some multi-year plan and not every project fits neatly within the current framework. Some projects complete work that was undertaken to meet other research needs. While the Agency's grants and intramural programs may provide research on areas of broad interest, including longer-term and emerging issues, their contribution to specific goals may be less apparent than the targeted research undertaken by the Agency. Therefore, it is not reasonable to expect that every project included in a multi-year plan will lead directly and logically to the fulfillment of the current long-term goals for that plan. (Annual performance measures are discussed in responses to charge questions 3a and b)

The Agency's plan to combine the Contaminated Sites and RCRA Multi-Year Plans into a single plan is appropriate given the size of the research programs and their content. The Panel recommends that the revised, integrated plan address the difficult question of how short-term research, long-term research, core research, and problem-driven research will be integrated to support the *Strategic Plan's* Goal 3 strategic targets. The Panel also recommends that the revised plan show how the various research activities connect to the *Strategic Plan's* Goal 3 targets (This is discussed further in the response to charge question 1b).

Charge question 1b – "Are the long-term goals supportive of meeting the Agency's strategic targets and focused on important issues?"

The Panel used the discussion of Goal 3 – Land Preservation and Restoration in *2003-2008 EPA Strategic Plan* to determine whether the long term goals in the Contaminated Sites and RCRA Multi-Year Plans address the Agency's strategic targets. The relevant sub-objectives from the *Strategic Plan* are:

3.1.1 Reducing waste generation and increase recycling
3.1.2 Managing hazardous wastes and petroleum products properly
3.2.1 Response to releases of harmful substances
3.2.2 Cleanup and reuse contaminated land
3.3.1 Provide science to preserve and remediate land
3.3.2 Conduct research to support this goal

The current long-term goals (articulated before the *Strategic Plan* was written) and the research supporting them generally support Agency's Goal 3. Most of the long-term

goals address the research (3.3.1 and 3.3.2 in the Multi-Year Plan) necessary to support targets in sub-objectives 3.1.2 and 3.2.2. of the *Strategic Plan*.

The separation of science and research objectives from the strategic targets for land preservation and restoration in the Strategic Plan makes it more difficult to provide a transparent mapping between Multi-Year Plan long-term goals and the research needs required to meet strategic targets identified in objectives 3.1 and 3.2. To the extent that the long-term goals of the relevant Multi-Year Plans are incorporated into the strategic science/research objectives of the Strategic Plan, this relationship needs to be more fully documented. While the Agency has indicated that in its strategic planning process each of the five strategic goals would have a science/research objective to acknowledge the role of science in the EPA mission, the Panel believes that a specific and transparent mapping of the elements of the Multi-Year Plan to the substantive goals of the Strategic Plan will improve the Multi-Year Plans and will optimize the use of scarce research dollars.

Based on their expert understanding of the science issues relating to waste generation, reuse, treatment, and disposal, the Panel agrees that the long-term goals described in the multi-year plans are focused on important issues. However, the Panel notes there is little research supporting the sub-objective 3.1.1 and none of the longer-term research necessary to address emerging issues (see additional details under the response to charge question 1e).

The Panel suggests that, for clarity, the revised plan link the long-term goals directly to the strategic targets in objectives 3.1 and 3.2 of the *Strategic Plan*. As required for the Program Assessment Rating Tool (PART) used by the Office of Management and Budget process, these long-term goals should be rewritten to be outcomes-oriented rather than output-oriented. The distribution of science and technical research activities by media, which is useful to OSWER, could be accomplished at the annual performance goal level.

> *Charge Question 1c - "Based on changes incorporated in the last revision of the* multi-year plans *, does multi-year planning lay out a balanced program addressing short-term and longer-term research to meet current needs and position the Agency to respond to emerging issues?*"

The organizational framework outlined in these multi-year plans could support a systematic approach for addressing both short-term and longer-term research. However, the combined influences of authorizing legislation, Congressional directives, OMB oversight, and limited budget push ORD efforts to focus on immediate needs of the CERCLA and RCRA program offices.

For reasons of institutional health as a research organization and because the Agency must be prepared to respond to emerging issues, the Panel recommends strongly that the Agency conduct research that looks far ahead (10+ years) to OSWER and national needs on these issues. This need is so compelling that additional funding would be ideal. However, given the realities of flat or decreasing budgets, if necessary, the Agency should

delay or reduce some research currently in the plans to provide funding for long-term research. (Charge question 2c discusses some possibilities for resource allocation.)

The Panel also recommends that the Agency implement a clearly-defined institutional process of continuous re-scoping to regularly identify and prioritize emerging research topics, as discussed in the response to Charge Questions 1e and 2a.

> *Charge question 1d – "Recognizing that the trust fund resources have to be accountable, how we might lay out long-term goals and complementary research themes in a* multi-year plan *that merges the two existing plans?"*

Ideally, research funded under the trust funds will complement research funded by other mechanisms where appropriate, or be independent, but not duplicative. While those who track resources may find it easier to read separately about the work supported by each trust fund, science-focused readers will find it convenient to read about research on a single topic in a single place in the revised plan. The discussion should acknowledge which portions of the research are supported by trust funds as necessary to meet accountability needs. This approach makes it easier to show that the research is complementary rather than duplicative.

At the simplest level, the annual performance goals and annual performance measures can be reorganized under the existing set of long-term goals to streamline the revised document. For example, several annual performance goals and annual performance measures associated with landfill covers could be grouped together. Additionally, aspects of RCRA corrective action and multimedia modeling could be organized with related annual performance goals under the Contaminated Sites Multi-Year Plan.

The Agency, however, has an opportunity to complete a more substantial revision of the Contaminated Sites and RCRA Multi-Year Plans as part of the process of combining them to better meet the expectations of the PART process and the organizational framework of the EPA's revised Strategic Plan. Therefore, the Panel recommends that the Agency redefine and reorganize the long-term goals, some specific themes, and some annual performance goals to better align with the sub-objectives and strategic targets in the Goal 3 – Preserve and Restore the Land. (See related comments in the response to charge question 1b)

> *Charge Question 1e – "In addition to emerging areas the Agency has identified, does the Panel see other potential emerging research areas that should be considered? If so, how might these areas be incorporated into a merged multi-year plan?"*

Both Multi-Year Plans described some forward looking projects (such as those related to the EPA's white paper, *Beyond RCRA*) as potential future research projects that could be pursued only if funds are available. Unfortunately, the budgets allocated for the two Multi-Year Plans appear to be barely sufficient to meet the shorter-term, immediate

needs in support of existing EPA programs and to conduct specific Congressionally-mandated research. The Agency has no difficulty identifying potential emerging research areas. The difficulty lies in finding a way to fund the work. (See responses to 1c, 2b and 2c)

From a scientific perspective, some examples of forward-looking research that would be valuable if funding became available or through reallocation of scarce funds are as follows:

1. Long-term management (10s to 100s of years) of drainage from abandoned mines as well as water and air emissions from large mining waste disposal sites; mitigation of environmental impacts of mining operations.

2. Long-term management (10s to 100s of years) of contaminated river and coastal sediments.

3. Those emerging areas, identified in "Beyond RCRA", and other related areas (e.g., innovative green labeling, product take-back, recycling, environmental marketing incentives, etc.)

4. Management of wastes associated with future technologies (e.g., nanotechnologies, fuel-cell technologies, technologies for harnessing various renewable and non-renewable energy sources, new battery technologies, etc.)

5. Development of energy-efficient waste and contaminated site remediation/treatment technologies

6. Development (further) of energy-recovery technologies from wastes, and technologies for production of biofuels from biomass waste (renewable energy).

7. Resource conservation issues associated with various industrial wastes in addition to those related to electronics waste identified in the Multi-Year Plan.

8. Fundamental industrial process changes and material substitutions to reduce hazardous and solid waste generation

9. Ultra-fine particles emissions to air, from waste generation or management operations (sources, characterization, health effects, and control)

2. For this update, what changes should be made to ensure that: the plans define a pathway that tracks program progress toward achieving the long-term

goals, consistent with the current state of the art, the role of ORD in the research community, and available resources.

Charge question 2a – "Is the planned research complementary to other research in this field?"

EPA's research complements work being done at other institutions. EPA's research in the Contaminated Sites and RCRA areas is both responsive to its own needs and takes advantage of opportunities where coordination, cooperation and partnering can realize research objectives and leverage scarce funds. The Agency has clearly established a range of official and substantive research collaborations with a number of government and private interests. The financial leveraging and opportunities for enhanced diffusion of scientific information afforded by these collaborative relationships have enabled ORD to maintain technically viable research programs in an environment of declining budgets.

Charge question 2b – "Is the distribution of resources across long term goals and themes appropriate?"

First, from the description of the work supporting the long-term goals within each plan, the Panel acknowledges that substantive work is planned or underway in each of the theme areas. However, the research funding framework and practices are significantly different among federal agencies, private industries and academia. This makes it difficult for SAB panels to understand the Agency's resource allocations. Without a detailed description of how the multi-year plans facilitate the selection and ranking of specific research activities, the Panel cannot document that the distribution of resources across long-term goals and themes is appropriate. However, based on the work described, oral presentations, and the Panel's general knowledge of waste research, there appear to be no inconsistencies in aligning program resources to specific research activities.

The Panel recommends that the subsequent combined Multi-Year Plan be organized very tightly with the Office of Management and Budget's PART process, and that each individual research activity be critically reviewed based upon the specific investment criteria for Relevance, Quality, and Performance in OMB Circular M-03-15 (dated June 5, 2003). If those investment criteria were applied in a consistent and transparent manner in the Multi-Year Plan, then the Panel could have readily answered this charge question. The Panel believes that ORD has gone through those processes and simply needs to reorganize much of that information into transparent documentation that provides a basis for accountability. The most practical approach may be to use the format required by OMB.

Second, within the bounds of the information provided, the Panel believes that the modest budget is stretched very thin to cover a wide range of annual performance goal and annual performance measures. This is commendable in terms of meeting the needs of the program and regional offices and getting the most research for the available resources. However, an exclusive focus on shorter-term science and technical needs will weaken the

research program over the long run, leaving it less well positioned to provide support on other needs as they emerge or to exercise scientific leadership.

Being a leader in the environmental research community is one of ORD's five organizational goals and meeting that goal requires some capacity for longer-term work on emerging issues. To be a leader implies recognizing issues and formulating approaches to resolving them earlier than others in the field. It also implies establishing scientific credibility, maintaining technical relevance and continuous improvement in generating, interpreting and applying the results of environmental research. If ORD is to position itself to assist the program office with new issues, ORD must achieve and maintain a balance between its proactive and reactive roles. Therefore, the Panel strongly recommends that a portion of the annual operating budget be allocated towards these longer-term and emerging issues that may not have clear, discernible short-term goals. Further, the Panel recommends that, to the extent that the Agency relies on its grants and intramural programs to address these needs, the connection between those programs and the long-term needs should be delineated—so that judgments about their adequacy can be made.

Third, recognizing that additional funding is not likely, the Panel attempted to identify possible sources of funding to be reprogrammed to support longer-term research on emerging issues. The Panel reviewed the budget information supplied by the Agency, and developed a simple cost-based ranking of the themes as a means of evaluating resource allocations. While the Panel hopes the results of this modest analysis will be helpful, these are opportunities only, not a substitute for the collective judgment of the research, program and regional offices on science and technical priorities.

Within the portfolio of projects identified in the RCRA and Contaminated Sites Multi-Year Plans, the Panel believed there were clear opportunities for efficiencies by combining some programs, reducing expectations in other programs, and reducing or eliminating other programs where clear leveraging opportunities with other government or private agencies could be identified.

Within the RCRA long-term goal 1: **Multi-media modeling,** the Panel felt that the EPA could identify and target project overlaps thereby improving science and cost efficiencies within other Agency tasks and goals.

There are some areas where the Panel would encourage the Agency to induce other government or private agencies conducting related research to expand their programs while still maintaining EPA access and presence. These areas include:

Contaminated Sites long-term goal 2:
DNAPLs in groundwater; and
Monitoring / measuring / screening contaminated sediments;

Contaminated Sites long-term goal 4
Exposure Assessment in a multi-media framework;

Contaminated Sites long-term goal 1
Modeling contaminated sediment, and

RCRA long-term goal 2:
Landfill containment and landfill bioreactors for waste management.

Some research targets could possibly be re-evaluated and perhaps moved to other programs or themes or even, in limited cases, be terminated to yield resources. For Contaminated Sites long-term goal 3: ***Analytical methods for use in contaminated soils/lands,*** the Panel recommends that EPA restrict the remaining methods development to emerging contaminants, and/or investigate moving them into other Multi-Year Plans , such as drinking water. Contaminated Sites long-term goal 3 ***Containment, remediation, and reutilization of contaminated soil/lands*** is a largely mature area where more science and technical work may be needed, but perhaps not as urgently as the need to establish a funding mechanism specifically designed for addressing longer-term emerging environmental issues.

Charge question 2c - "Given the resources available, is the program appropriately focused on Agency priorities and emerging needs?"

The Panel felt that this charge question is similar to Question 2b, *Is the distribution of resources across long-term goals and themes appropriate,* and thus the responses to Question 2c should be considered in conjunction with Question 2b.

The research program responds credibly to the Agency's shorter-term problem-driven science and technical priorities. However, there is no science or technical research program specifically targeting emerging environmental needs. Research on emerging environmental protection needs is so important that, in its response to charge question 1c, the Panel recommended that, if necessary, resources be reallocated from the current program to provide financial support for the science and technical research activities necessary to address emerging environmental issues.

The question of resource reallocation is difficult. The Panel discussed the relative merits of each long-term goal under both plans to identify possible areas from which such funds could be diverted. This review is captured in the response to charge question 2b.

As a final note, if ORD accepts this recommended approach then the Panel would be interested in assisting the Agency in identifying and defining the specific long-term goals needed to address emerging longer-term issues and the associated annual performance measures and annual performance goals. A possible mechanism for such assistance would be an SAB consultation.

3. For this update, what changes should be made to ensure that the diagrams and Annual Performance Measure and Annual Performance Goal tables are effective tools to communicate the work we plan to do and will be useful in documenting accomplishments.

> Charge question 3a – "Is it clear that the research products (annual performance measures and annual performance goals) are supportive of the Agency's strategic targets?"

By comparing the long-term goals to the Agency's strategic targets, the Panel determined that each long-term goal related to one or more of the strategic targets. Because the research products are organized by long-term goal, they also support the strategic targets.

To make it easier to understand these relationships, the Panel recommends that the revised plan map the annual performance measures and goals to specific long-term goals and align the long-term goals to the Agency's new strategic targets, reformatting the research outputs so that the reader can easily perform a simple cross-walk between Multi-Year Plan outputs and specific components of the Agency strategic targets. Also, the Panel recommends that the new long-term goals, annual performance goals and annual performance measures be phrased to reflect the technical content or area of the projects they encompass. Ideally, they will also be consistent with the assessment guidelines of the Government Performance and Results Act and the Office of Management and Budget's PART process.

The Panel recommends that the Agency continue to improve the annual performance measures to better reflect the intended/expected outcomes of ORD's efforts in supporting the Agency's strategic targets. Establishing appropriate metrics for research programs is not an easy task, principally because the amount of time it takes for research to go from publication to application is much longer than the time period for which managers hold researchers accountable for progress. What can be readily measured in the short-term is often only an indirect and imprecise indicator of what is to be accomplished in the long-term -- an output rather than an outcome. The Agency staff who briefed the Panel are fully aware of the importance of establishing better metrics and the difficulties of doing so. They should continue to work this problem.

Annual performance measures should be selected carefully in consultation with technical personnel to ensure realistic numeric targets are selected. In the Panel's view, it is acceptable for the annual performance measures to include outputs. However, where possible, the annual performance goals should be designed and measured as outcomes. Because presentations and discussions with ORD staff revealed extensive and successful leveraging throughout many of the ORD activities, it would be helpful to capture this in the annual performance goals and measures as well as to describe the philosophy for optimizing use of ORD resources. (See also responses to charge questions 1b and 3b.)

Charge question 3b – "Do the annual performance measures *and* annual performance goals *show a logical progression toward meeting the long-term goals?"*

Within the multi-year plans, achievement of a specific long-term goal depends on the satisfactory completion of annual performance goals, which, in turn are characterized by annual performance measures. In concept, the role and function of annual performance goals and measures in the process of meeting long-term goals is logical, clear and defensible. In practice, there are three problems. First, a few projects will fit well (for the reasons given in 1a). Second, describing how the ORD research program is coordinated with overall Agency goals, i.e., all the way from projects to strategic targets, is challenging. Finally, finding meaningful quantitative annual performance measures is difficult. The Panel's recommendations on this issue appear in the discussion under question 3a.

The description of program integration can be improved through refinements of the Multi-Year Plan flow diagrams. These diagrams illustrate the overall delivery schedule of the more detailed information contained in the annual performance goals and measures description tables. The Panel recommends that the flow diagrams more clearly and succinctly illustrate the connections between the *Strategic Plan*, long-term goals, annual performance goals and annual performance measures.

The current Multi-Year Plans list and describe the projects covered. Project presentations could be strengthened by including narrative summaries that address the Agency's plans for dissemination of the research results to the appropriate stakeholders. This aspect of the ORD program could be effectively achieved by mapping the linkages from annual performance measure to annual performance goal to long-term goal and ultimately to the Agency Strategic Goals. The Panel also recommends that the revised and consolidated multi-year plan include a synthesized description of how each group of research projects addresses particular outcomes and fills critical science and technical research gaps

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BIOSKETCHES FOR PANELISTS

Contaminated Sites and RCRA Multi-Year Plan Advisory Panel	
Clark, James	James R. Clark: Dr. Clark is a Distinguished Scientific Associate who joined Exxon in 1992, after a twelve-year career as a research biologist with the US Environmental Protection Agency. He earned a B.S. in Fisheries at the University of Michigan, and an M.S. and Ph.D. in Zoology and Aquatic Ecology from Virginia Polytechnic Institute and State University (Virginia Tech). Dr. Clark has extensive experience in laboratory and field assessments of petroleum industry products and activities, complex effluents, contaminated soils and sediments as well as pesticides and industrial chemicals. He has developed and applied ecological hazard and risk assessment approaches to address a wide variety of environmental issues. Dr. Clark was responsible for environmental assessments of the bioremediation technology developed and applied during the Alaskan Oil Spill clean-up program. Currently, he heads ExxonMobil's Oil Spill Research Program and plays a corporate and industry leadership role in the development and evaluation of environmentally relevant techniques and strategies for oil and chemical spill response. Dr. Clark is active in several professional/technical organizations involved with ecological risk assessment and serves on a number of professional, academic, and governmental advisory panels. These include serving as an appointed member of USEPA's ORD Board of Scientific Councilors (since 2000); participation in the American Chemistry Council Long-Range Research Program Technical Implementation Panel for Ecosystem Dynamics, Environmental Exposure, Ecological Risk Assessment / Risk Management (Co-Chair1996-2001); and serving on the Science Advisory Committee for the University of MD Multiscale Experimental Ecosystem Research Center, a USEPA-funded program (1992-2001). Dr. Clark serves on the editorial board of the Journal of Human and Ecological Risk Assessment (since 1992), and has served two, three-year terms on the editorial board for Environmental Toxicology and Chemistry (1986-1989; 1991-1994). He is an active member of the American Association for the Advancement of Science, Ecological Society of America, and Society for Environmental Toxicology and Chemistry. Dr. Clark has authored over 70 peer-reviewed publications, and 90 presentations at national meetings and symposia.
Crittenden, John C.	John C. Crittenden is Richard Snell Presidential Chair of Civil and Environmental Engineering, Department of Civil and at Arizona State University. He received a B.S. in Chemical Engineering and was awarded M.S. and PhD in Civil and Environmental Engineering by the University of Michigan. Dr. Crittenden's main research and teaching interests have been in these areas: Sustainability, Pollution Prevention, Physical-Chemical Treatment Processes (Ion Exchange, Oxidation processes, Catalytic Oxidation, Photocatalytic Oxidation, Electrocatalysis, Adsorption, Electro-Adsorption, Air Stripping), Transport of Organics in Saturated and Unsaturated Groundwater, Modeling of Fixed-Bed Reactors and Adsorbers (Photocatalysis, Low Temperature Catalysis in Aqueous and Gas Phases, Transport of Organics in Saturated and Unsaturated Groundwater), Sol-Gel Chemistry for Preparation of Zeolites and Catalysts, Surface Chemistry and Thermodynamics (Prediction of Adsorption Capacities and Surface Catalyzed Rate Constants), Mass Transfer, Numerical Methods, Modeling of Wastewater and Water

	Treatment Processes. Dr. Crittenden has successfully directed over 36 research projects with a total budget of over 20 million dollars. Some of the more notable projects he has been responsible for include: 1) Center for Clean Industry and Treatment Technologies (This is a 8 year project funded at a level of 10 million dollars.); 2) the development of a process which uses sunlight or artificial lights, photocatalysts and adsorbents to destroy aqueous and gas phase organic contaminants; and 3) an evaluation of the water treatment system for the space station Freedom. The research projects which he has directed or been involved with over the past 20 years have resulted in over 100 publications including reports, journal articles, 2 patents, contributions to colloquia and conferences, and a book. Dr. Crittenden and his students have received 14 national awards including the ASCE Huber Research Prize, two American Water Works Association best paper awards, two Water Environment Federation best paper awards, and the ASCE Rudolph Hering medal. In recognition of Dr. Crittenden's contributions to engineering, he was elected to the National Academy of Engineering in 2002. Dr. Crittenden is Director of the Sustainable Technologies Program at Arizona State and Associate Editor of Environmental Science and Technology.
Dellinger, H. Barry	Dr. Barry Dellinger is the Patrick F. Taylor Chair of the Environmental Impact of Treatment of Hazardous Wastes and Professor of Chemistry at Louisiana State University. He is the Director of the LSU Intercollege Environmental Co-operative. He is a member of the US-EPA Science Advisory Board Environmental Engineering Committee. From 1981 to 1998, he was Group Leader of Environmental Sciences and Engineering at the University of Dayton where he also held a joint faculty appointment. From 1978-1981he was a Senior Project Scientist at Northrop Services Inc. He was a post-doctoral fellow at the University of Pennsylvania from 1976-1978.He holds a PhD in Physical Chemistry from Florida State University and B.S. in Chemistry from the University of North Carolina at Chapel Hill. His research interests include origin and control of toxic combustion by-products, mechanisms of formation and reactivity of combustion-generated nanoparticles, pathways of formation of dioxins, gas-phase/surface catalyzed elementary reaction kinetics, and thermal treatment of hazardous wastes,. He is a recipient of the Charles A. Lindberg Certificate of Merit, the Engineering and Science Foundation Award for Outstanding Professional Achievement, the Wohleben-Hochwald Researcher of the Year Award, the Ohio General Assembly Award for Research Excellence, and co-recipient of numerous EPA STAR research awards. He currently serves as the Chair of the Steering Committee of the International Congress on Toxic Combustion By-Products and the Board of the Diagnostic Instrumentation and Analysis Laboratory at Mississippi State University. Ongoing Grants and Contracts§ National Science Foundation (09/01/2003 - 08/31/2006)Project title: The Origin and Nature of Persistent, Combustion-Generated Radicals§ National Science Foundation (09/01/2003 - 09/01/2004)Project title: Wide-Area 2D IR Tomography for Tracking and Neutralization of Reactive Plumes§ EPA (09/04/2000 - 09/31/2004)Project title: Toward the Development of a Detailed Mechanism of Transition Metal Catalyzed Formation of PCDD/F from Combustion-Generated Hydrocarbons§ NIEHS (10/01/2002 - 12/31/2004)Project title: International Congress on Toxic Combustion By-Products§ Phillip Morris, USA (07/29/2002 - 06/20/2004)Project title: Investigation of Persistent Radicals in Tobacco Smoke.

Dzombak, David	David A. Dzombak is a Professor of Civil and Environmental Engineering at Carnegie Mellon University, a registered Professional Engineer in Pennsylvania, and a Diplomate of the American Academy of Environmental Engineers. He holds a Ph.D. in Civil-Environmental Engineering from the Massachusetts Institute of Technology, an M.S. in Civil-Environmental Engineering from Carnegie Mellon University, a B.S. in Civil Engineering from Carnegie Mellon University, and a B.A. in Mathematics from Saint Vincent College. Dr. Dzombak's expertise is in water and soil/sediment quality engineering, especially the fate and transport of chemicals in subsurface systems and sediments, wastewater treatment, in situ and ex situ soil/sediment treatment, hazardous waste site remediation, and abandoned mine drainage remediation. Dr. Dzombak has served on the National Research Council Committee on Bioavailability of Contaminants in Soils and Sediments, and on various research review panels for the Department of Defense, Environmental Protection Agency, National Institute of Environmental Health Sciences, and National Science Foundation. He has also served on the Board of Directors and as an Officer of the Association of Environmental Engineering and Science Professors; as chair of committees for the American Academy of Environmental Engineers, American Society of Civil Engineers, and Water Environment Federation; and on advisory committees for various community and local government organizations, and for the Commonwealth of Pennsylvania. Dr. Dzombak was elected a Fellow of the American Society of Civil Engineers in 2002. Other recent awards and honors include an Aldo Leopold Leadership Program Fellowship from the Ecological Society of America and The David and Lucile Packard Foundation in 2000, the Professional Research Award from the Water Environment Association of Pennsylvania in 2002, and the Jack Edward McKee Medal from the Water Environment Foundation in 2000. Dr. Dzombak's research support over the past two years has come from Alcoa, David and Lucile Packard Foundation, Gas Technology Institute, National Science Foundation, Pennsylvania Infrastructure Technology Alliance, U.S. Environmental Protection Agency, and the Water Environment Research Foundation
Eighmy, T. Taylor	Taylor Eighmy is a Research Professor of Civil Engineering at the University of New Hampshire (UNH). He received his B.S. in Biology from Tufts University in 1980, his M.S. in Civil Engineering from UNH in 1983, and his Ph.D. in Engineering (Civil) from UNH in 1986. Dr. Eighmy directs the Environmental Research Group (ERG), an applied environmental engineering and environmental science research center at UNH. He also directs the Recycled Materials Resource Center (RMRC), a partnership with the Federal Highway Administration, to promote the wise use of recycled materials in highway construction. He presently serves on the Advisory Board of the New Hampshire Estuaries Project, a partnership between the New Hampshire Office of State Planning and the U.S. EPA's National Estuaries Program. He also serves on the National Steering Committee of the U.S. DOE's Combustion Byproduct Recycling Consortium. Formerly, he was appointed to and served on the New Hampshire Waste Management Council (1988-1995); the Council has solid and hazardous waste adjudicatory and rule making authority. He was a member of the International Ash Working Group (IAWG), sponsored by the International Energy Agency, and coauthored the treatise "Municipal Solid Waste Incinerator Residues" with his IAWG colleagues. He received the UNH Excellence in Research Award in 1997. He has research interests in recycled materials characterization and beneficial use, chemical speciation, environmental chemistry of leaching behavior, spectroscopic surface analysis,

	applied geochemistry, reactive barriers, and environmental microbiology. Dr. Eighmy's present research focus is on contaminant leaching and leaching modeling, use of surface spectroscopy to characterize surfaces where leaching first occurs, contaminant fate and transport in beneficial use scenarios within the highway environment, phosphate stabilization of wastes, use of phosphate-based reactive barriers (both permeable and impermeable) for waste containment, and geochemical and microbial characterization of micro fracture surfaces in TCE-contaminated bedrock. His present research is supported by FHWA, NOAA, U.S. EPA, the European Union, and the private sector.
Hughes, Joseph B.	Joseph B. Hughes is Professor and Chair in the School of Civil and Environmental Engineering at Georgia Institute of Technology. After earning a B.A. in Chemistry from Cornell College in Mount Vernon, Iowa, he was awarded and M.S. and Ph.D. in Civil and Environmental Engineering from The University of Iowa. Dr, Hughes is a Registered Professional Engineer in the State of Texas. His research interests lie in the area of biological treatment of wastes and the bioremediation of contaminated sites, soil, and groundwater, especially anaerobic processes. He is Member and Chair, West Coast Hazardous Substances Research Center Science Advisory Board, 2002-present, member of the Association of Environmental Engineering and Science Professors (AEESP) Strategic Planning Committee, 2002 and of the National Research Council Committee on Bioavailability of Contaminants in Soils and Sediments, 2000 to present.
Kim, Byung	Byung R. Kim is Technical Leader in the Physical and Environmental Sciences Department of Ford Research and Advanced Engineering, Dearborn, MI and is a professional engineer. He received the B.S. degree in Civil Engineering from Seoul National University in Korea in 1971 and M.S. and Ph.D. degrees in Environmental Engineering from the University of Illinois, Urbana, IL in 1974 and 1977, respectively. Before joining Ford, he worked as an environmental engineer for Tennessee Valley Authority, taught at the Georgia Institute of Technology, and was a researcher at General Motors Research Laboratories. His current research interest is in understanding various manufacturing emission issues (physical/chemical/biological waste treatment processes and the overall environmental impact of manufacturing processes). He also has worked on the adsorption of organics on activated carbon and water quality modeling. He has served on EPA SAB Environmental Engineering Committee and was Editor of the Journal of Environmental Engineering, American Society of Civil Engineers (ASCE). He served on the advisory board for the National Institute of Environmental Health Superfund Basic Research Program at the University of Cincinnati. He received a Richard R. Torrens Award for editorial leadership from ASCE and two Willem Rudolfs Medals from Water Environment Federation on his publications in industrial wastes. He has not received any external research funding in the last few years.
Lifset, Reid	Reid J. Lifset is the Associate Director of the Industrial Environmental Management Program and a member of the faculty at the Yale University School of Forestry and Environmental Studies. He did his graduate work in political science at the Massachusetts Institute of Technology and in management at Yale University. His research focuses on the application of industrial ecology to novel problems and research areas, and the evolution of extended producer responsibility. He is currently principle investigator on the Luce Foundation-funded project "Collaborative Industrial Ecology in Asia", a co-principal investigator in the Stocks and Flows (STAF) project at the Yale Center for Industrial

	Ecology, funded by the National Science Foundation (NSF) and the Nickel Development Institute (NiDI). He is a co-principal investigator on National Institute of Standards & Technology (NIST) and NSF-funded projects on the environmental assessment of bio-based materials. Other recent sources of support include the Garfield Foundation, the U.N. Environment Program and the Hixon Center for Urban Ecology at Yale. He is the editor-in-chief of the Journal of Industrial Ecology, an international quarterly on industry and the environment, headquartered at and owned by Yale University and published by MIT Press. He has served as a consultant to the Science Advisory Board of the U.S. EPA, and is a member of the governing council of the International Society for Industrial Ecology (ISIE), and the Science Advisory Board of Material Flow Analysis for Sustainable Resource Management (MFAStorM) of the Scientific Committee on Problems of the Environment (SCOPE).
McFarland, Michael J.	Dr. Michael J. McFarland received his bachelors' degree in Engineering and Applied Science from Yale University, his masters' degree in Chemical Engineering from Cornell University, his Ph.D. in Agricultural Engineering from Cornell University and completed his postdoctoral research program in the Dept. of Civil and Environmental Engineering at the University of Texas at Austin. Dr. McFarland is currently an associate professor in the Department of Civil and Environmental Engineering at Utah State University where his research interests are focused in the areas of air quality management, biosolids engineering, industrial waste management and pollution prevention. Dr. McFarland has served on numerous federal, state and local environmental engineering and public health advisory committees for the US Dept. of Defense, US Environmental Protection Agency, US Dept. of Energy, National Science Foundation, Utah Dept. of Environmental Quality and Cache County, Utah. Dr. McFarland has authored or coauthored over fifty publications in the field of environmental engineering including the recent textbook "Biosolids Engineering" (McGraw-Hill, 2001)as well as numerous research journal articles, conference proceedings and professional engineering (PE) licensing workbooks. Dr. McFarland is a registered professional engineer in the State of Utah and currently holds Grade IV operator certifications for both wastewater and water treatment. Dr. McFarland is a Diplomate of the American Academy of Environmental Engineers (AAEE) as well as a member of several professional environmental science and engineering organizations including the Water Environment Federation (WEF), Society for Risk Analysis, National Biosolids Partnership and the Association of Environmental Engineering and Science Professors (AEESP).
Powers, Susan E.	Susan E. Powers is a Professor in the Department of Civil and Environmental Engineering at Clarkson University. She received her PhD in Environmental Engineering from the University of Michigan in 1992. Dr. Powers' research has focused on understanding the physical and chemical phenomena associated with contaminant transport in subsurface systems, with specific emphasis on organic non-aqueous phase liquids (NAPLs) in complex systems. Her research on NAPL dissolution, the wettability of NAPL-water-mineral systems and the fate of ethanol-blended gasoline in the subsurface is widely cited and considered at the leading edge in her field. Experimental and mathematical modeling techniques are utilized in all research activities. Research that has provided a solid understanding of the environmental fate of oxygenated gasoline has lead to an interest in the application of this science to aid in regulatory and policy decisions. Current projects in this area include life cycle management issues for gasoline, other transportation fuels and energy systems in

	general. Funding for her research projects has been received from the EPA STAR program, NSF, DOE 's Environmental Science Management Program and the State of California through LLNL. Dr. Powers has been an invited participant at many workshops and symposia related to the environmental impacts of reformulated gasoline. She has served on the Board of the Association of Environmental Engineering and Science Professors and the editorial boards for the Journal of Environmental Engineering, Advances in Water Resources and the Journal of Contaminant Hydrology.
Shaw, Bryan	Bryan W. Shaw, PhD, is an Associate Professor and member of the Center for Agricultural Air Quality Engineering and Science in the Biological &Agricultural Engineering Department, Texas A&M University. He received his Bachelor of Science and Master of Science degrees in Agricultural Engineering from Texas A&M University and his Ph.D. in Agricultural Engineering from the University of Illinois at Urbana-Champaign. Dr. Shaw teaches and conducts air quality research on topics including development of accurate emission factors for feed and grain handling, emissions from cattle feed yards, development of air pollution dispersion models, and fugitive dust emissions from field operations. Dr. Shaw recently spent one year working with USDA-NRCS as Special Assistant to the Chief under an Interagency Personnel Agreement. In this role he provided national leadership in the development of policies and programs to address agricultural air quality concerns.
Smith, John R.	John R. Smith has over 25 years experience in the environmental sciences and engineering field where he has dealt with numerous aspects of site remediation, treatment of plant process waters and wastewaters, and sustainable development technology initiatives. He has a Ph.D. in Civil/Environmental Engineering from Carnegie-Mellon University and is a registered professional engineer in Pennsylvania. Dr. Smith is recipient of the Best Research Paper Award from the American Society of Civil Engineers Practice Periodical in 2001, the Jack Edward McKee Medal from the Water Environment Foundation in 2000, and the Linn H. Enslow Memorial Award from the New York State Water Association in 1994. He is currently employed with Alcoa Inc. and is also an Adjunct Professor in the Civil/Environmental Engineering Department at Carnegie-Mellon University. At Alcoa Inc., Dr. Smith manages the EHS Sciences & Technology Section. Presently, his main focus is to establish sustainable development initiatives within Alcoa via the innovative integration of EHS (environment, health, safety) into all new and existing products and production processes. Such work specifically relates to developing, evaluating and implementing technically viable and cost-efficient ways to treat, minimize and/or eliminate water and wastewater discharges, solid waste generation, and air pollutant discharges by addressing such issues via innovative modifications to production process and/or operations, rather than the more conventional end-of-pipe treatment approaches. Focus is also given to implementing energy efficiency, safe work practices and providing a healthy work environment associated with production operations. Here, the ultimate goal is to first address, and then move beyond, EHS compliance in a cost-efficient manner while at the same time moving towards more efficient production and more sustainable products, thus providing Alcoa, their employees and the communities in which they operate with a safe and sustainable future. Dr. Smith also provides remediation consulting within Alcoa on strategically significant issues.

Thompson, Timothy	Mr. Thompson is a senior environmental scientist with SEE, LLC, and is a nationally recognized leader in the field of characterization and management of contaminated sediments. He received his B.Sc. in Agricultural Sciences from the University of Arizona, his M.Sc. in Ocean Sciences from the University of British Columbia, and was a Monbusho Fellow, at the University of Nagasaki and Tokyo Fisheries University, Japan. In his 17 years of experience, Mr. Thompson has served as program manager and principal scientist for several large contaminated sediment programs under CERCLA and RCRA, and has particular expertise in sediment capping design and implementation. His current work in sediments also includes habitat evaluations and integration of field data with spatial modeling tools, spatial characterization and statistical analysis of bedded sediment data, bedded sediment characterization, water quality monitoring, and ecological risk assessment. He is a member of EPA's Science Advisory Board Environmental Processes and Effects Committee, and sits on request with the Environmental Engineering Committee. He is a peer reviewer for the Hudson River CERCLA Ecological Risk Assessment and for the Engineering Performance Standards. He also recently completed peer review for the Housatonic River Ecological Risk Assessment. His recent contract experience includes both industry and federal/state agencies, ranging from large multi-national oil firms to the U.S. Navy and the Corps of Engineers. Mr. Thompson has numerous publications on ecological risk assessment, contaminated sediment management, and sediment capping techniques.