Science Integration Fact-finding Discussion Summaries 2009-2010 -Table of Contents

EPA Region 1 New England Science Integration for Decision Making Fact-Finding Interviews
October 28, 2009
1 Congress St, Boston, MA

Three members of the SAB Committee on Science Integration for Decision Making conducted three interviews in EPA Region 1: Drs. Deborah Cory-Slechta and James Johnson conducted the interviews in person and Dr. Wayne Landis participated by phone. For each interview, Dr. Vanessa Vu, Director of the SAB Staff Office, provided a brief introduction to the purpose of the interview and the Designated Federal Officer, Dr. Angela Nugent, took notes to develop a summary of the conversation. All interviewees were provided a copy of the committee's Preliminary Study Plan in advance.

Dr. Vu noted in each interview that the purpose of the interview was to help SAB Committee members learn about Region 1's current and recent experience with science integration supporting EPA decision making so that the SAB can develop advice to support and/or strengthen Agency science integration efforts. Dr. Vu thanked participants for taking time for the interviews and thanked Michael Kenyon for serving as liaison with the SAB Staff Office in planning the interviews.

Interview with Mr. Ira Leighton, Acting Regional Administrator
October 28, 2009, 9:30 a.m. - 10:30 a.m.
In attendance:
Michael Kenyon, Director, EPA New England Regional Laboratory
Robert Hillger, Senior Science Advisor – ORD Liaison

Acting Regional Administrator Leighton welcomed the SAB members to Region 1 and commended the SAB for visiting all 10 regions. He predicted that the SAB members will hear one common message across the regions: there is a strong connection between solving environmental problems and the regions. No matter what the national priorities may be, environmental problems are ultimately about people, ecosystems, rivers, streams and what is impacting them. Problem solving requires a focus on science and technology. Region 1 New England organized an information package for the SAB that has a problem solving focus. Discussions that may start as a national policy dialogue typically lead to the development of specific tools to give decision makers at the regional, state and local levels choices for problem solving. Successful environmental decisions have "real science embedded in them which demonstrates our commitment to the technical integrity of our decision making." Whenever EPA Region 1-New England's Science Council debates a cutting-edge issue, "someone will ask 'what is the specific tool that will translate this policy into decision making.'" He complimented Mike Kenyon, Director of the Office of Environmental Measurement and Evaluation, Mr. Robert Hillger, Regional Science Advisor and ORD Liaison, and the regional Office Directors for helping the Science Council be so effective.

When EPA only focuses on engaging science at a high level of policy issues, the Agency only captures half its science needs. He

expressed the view that the report should address the need for applied science and how applied science could be better reflected in the Agency's science agenda.

Mr. Leighton provided some context for his concern for applied science. He observed that EPA plays a significant on-the-ground role in managing Superfund clean-ups in New England. EPA also runs the water programs in Massachusetts and New Hampshire and administers the Clean Air Act's Prevention of Significant Deterioration (PSD) permit program in Massachusetts. A good example of the region's need for applied science arose with the implementation of the Clean Water Act 316(b) regulations related to cooling water intake and the discharge of heated water. This issue required Region 1 to take a leadership role in interpreting and applying regulations. As part of its permitting of the Dominion Electric Brayton Point power plant, the region needed to justify its decision requiring the plant to implement closed cycling in response to expert litigants' challenges to EPA's science. To support its decision, the region developed tools and worked with ORD's Narragansett laboratory on juvenile flounder studies. The region had invested in a staff person to return to graduate school and get a Ph.D.to assist with this work. The individual was able to work with ORD's Narragansett laboratory and conduct a research study with ORD on the impact of thermal discharge on flounder fecundity studies. The decision upholding Region 1-New England's science was significant for EPA and the environment. In Mr. Leighton's view, "If we don't have the right tools from EPA's research program…if we can't develop capabilities to have our biologists operating at highest levels, we'll be outgunned."

Committee members asked how the region consistently maintains and obtains the high level of science needed to support decision making. Mr. Leighton responded by asking Mr. Hillger to provide the Designated Federal Officer with the region's responses to the scientific integrity survey conducted by the EPA Office of the Science Advisor. Mr. Leighton noted that the key to maintaining a high level of scientific capability is investment in infrastructure. A region must commit to maintaining and honing science skills. He voiced his pride in Region 1 New England's Regional Science Council, which identifies science and scientific skills most relevant to the Region's work. The Council also identifies high quality speakers on topics related to the region's priorities and organizes a seminar series with distinguished speakers from institutions such as Harvard and MIT. Seminars are very well attended. Investment in science is not driven from the top alone; commitment to high quality science is diffused through the organization.

The region also tries to strengthen connections with ORD. When Region 1 New England was lead region for ORD, Mr. Leighton and the regional scientists tried hard to strengthen connections between what ORD offers and decisions faced by regions. Region 1 organized a formal "Science Summit" and "Progress Review" with ORD senior management and identified priority science needs. More importantly, the Region helped conceive a better way of doing business collectively to ensure that Agency science was helping solve real pragmatic environmental problems the regions faced daily in meeting their obligations to the regulatory mission of the Agency. Unfortunately, the region did not "push those priorities across the finish line." Mr. Leighton asked Mr. Hillger to provide the Designated Federal Officer with a summary of the recommendations from the problem-solving summit.

Mr. Leighton also mentioned that "simple ideas make big differences" in ensuring that regional decision makers have the science needed to back up their decisions. He noted that ORD has a well-established mechanism to reward peer reviewed papers, but "there isn't a comparable award for a scientist whose efforts help make a $300 million decision come out right." Such a new award could help re-orient some ORD research. He also noted that the Regional Science Advisor and ORD Liaison , Mr. Hillger, has taken the initiative to strengthen Region 1 New England connections with STAR grant recipients in the region. Mr. Hillger has organized workshops to bring STAR-grant recipients together with regional science practitioners to discuss the relationship between their STAR grant research and EPA problems. Principal investigators welcomed these well-attended workshops and discovered opportunities to reorient their research in some minor ways that would produce products of greater relevance to decision makers. Mr. Leighton felt such workshops should be institutionalized more formally.

Mr. Leighton also spoke about Region 1 New England's use of the new ORD Science Connector, which strengthens regional scientists' awareness of research and science activities in ORD and across the agency.

Maintaining and enhancing regional science happens, in Mr. Leighton's view, because it reflects a particular attitude towards EPA's relationship with science. He said that "You do it because you think you're joining an elite organization." The reason why he initially joined EPA is the same reason why top-notch scientists are still attracted. If EPA managers really build the infrastructure needed for science and "EPA maintains its ability to attract the next generation of scientists and engineers, we will continue to be a strong scientific agency." He noted that recruitment is especially important now, because EPA will be losing institutional knowledge as large numbers of scientists retire. "There has never been a more important time to have science applied to local problems and problem solving."

Mr. Leighton told a "real-world story that gave him passion" for this topic. In his former role as senior official with responsibility for remedy decisions, sometimes costing more than $400 million, he "wanted to get the decisions right." To support such decisions, a team would meet with him and provide the available information supporting the record of decision. There would typically be a lawyer, hydrogeologist, risk assessor, and engineer. Sometimes, the team would be "sort of together and sort of fractured." One time, he was going through a briefing at the end of the fiscal year and had almost reached a decision, when someone off in a corner said "your choice is to do sham science and sign the Record of Decision (ROD) or not make the decision." He felt that such a choice was unacceptable. As a result, now whenever he meets with people teeing science up, he tells them, "Your job is to drive science with 'high beams'. I'm not putting up with a last-minute option to use 'sham science' for regional decisions." He asks staff to plan two years ahead for the science needed for site clean-up decisions. Regional scientists and managers and the Regional Science Council have the job of knowing the decisions in the pipeline and telling the Regional Administrator and the region what's needed. Mr. Leighton said that he is committed to listening to staff and supporting science needs. He says that managers must demand such planning for high quality science. They should not expect that good science will "happen organically"--that things will come together by themselves.

An SAB committee member asked about how the region maintained "science neutrality" and whether it had guidelines for neutrality. Mr. Leighton responded that an important regional mechanism supporting high quality, neutral science is use of a "community of practice." At key stages in the decision, especially in the clean-up programs, project teams are required to make a presentation to the responsible managers. The region invites other project teams to hear their approach to the science supporting record of decision. These open discussions "gradually ratchet up the quality of dialogue over time" and the quality of science improves. Scientists exchange ideas and interpretations and advance the community of practice.

A committee member asked about involving stakeholders in formulating problems for science support. Mr. Leighton responded that the Superfund program has a mechanism for providing a community with independent technical expertise. This mechanism gives citizens access to technical information and allows them to present an informed, independent perspective. Superfund has used this program to great advantage.

Mr. Leighton noted that regional science has stood up well to scrutiny and challenge in controversial cases. The General Electric Housatonic case, for example, involved public health and ecological risk. EPA and the responsible party agreed to a consent decree involving an independent review of science supporting EPA's decision. EPA and the litigant jointly agreed on peer reviewers who vetted EPA's view of the science supporting the environmental decision and supported EPA's interpretation, thereby sustaining the decision.

Interview with EPA Region 1-New England Managers
October 28, 2009, 10:30-12:00 a.m.

EPA Region 1-New England Participants

Mr. Stephen Perkins, Acting Deputy Assistant Regional Administrator
Mr. Michael Kenyon, Director, Office of Environmental Measurement and Evaluation (OEME)
Mr. Gerry Sotolongo, Chief, Quality Assurance, OEME
Mr. David Webster, Chief, Industrial Permits Branch, Office of Ecosystem Protection (OEP)
Ms. Cynthia Greene, Chief, Energy and Transportation Unit, OEP
Ms. Ida McDonnell, Chief, Air Permits, Toxics and Indoor Programs Unit, OEP
Mr. Mel Cote, Chief, Ocean and Coastal Protection Unit, OEP
Mr. Steven Rapp, Chief, Acting Manager, Technical Enforcement Office, Office of Environmental Stewardship (OES)
Mr. Michael Jasinski, Chief, NH/RI Superfund Section, Office of Site Remediation and Restoration (OSRR)
Ms. Meghan Cassidy, Chief, Technical and Enforcement Section, OSRR
Mr. Robert Hillger, Regional Science Adviser – ORD Liaison

SAB committee members invited participants to address questions in the committee's *Preliminary Study Plan* and to identify the types of science-based decisions made in their organizations, their roles, the kinds of science they use and need, impediments to using science, and how they deal with uncertainty. Participants took turns providing responses to committee members' questions.

The first participant noted that regions generally make site-specific decision, rather than sweeping decisions at a larger geographic scale. The largest scale for a Region 1-New England decision might be made at the estuary level. In his view, the region's "last big water pollution frontier" is stormwater impacts. Fifty per cent of streams are impaired by stormwater discharges. The University of New Hampshire Stormwater Center provides a test bed of technologies that can be applied and Region 1-New England is currently building a network of technologies and an information clearinghouse to access expertise outside EPA. EPA just sponsored a workshop for information sharing about available tools for permit writers from across three regions. In a later comment, another participant noted that although the region generally makes site-specific decisions, each decision can have broader implications and set a precedent in Region 1-New England and nationally.

Another participant spoke of the science integration needs in the region's ocean and coastal programs, which have direct responsibility for half a dozen major program areas. Needs include:

- Technical support for National Pollutant Discharge Elimination System (NPDES) permits for power plant intake and discharge.
- National Environmental Protection Act reviews for off-shore waters, large-scale commercial wind farms, and electric transmission.

- Water quality impacts of off-shore development projects involve dredging and disposal.
- Beach monitoring, where there is a need to get faster results from sampling to inform the public in a timely manner with regards to beach closures and warning decisions.
- Nutrients management (nitrogen and phosphorus).
    - Science needed to determine right concentration for effluent limits.
    - Need to understand the extent to which nutrient occurrence may be related to red tide occurrences which have been increasing over 15 years. Information related to Pfisteria in the Chesapeake Bay may not be relevant to red tide issues in New England.

The region has needed science for many of these cases, but the scientist noted that often "we have more information than we have political will and people to address."

A committee member asked whether the region lacked site-specific information needed for decision making. One manager noted that literature reviews undertaken to assess impacts of thermal discharge from power plants often do not identify the size of affected fish, species, and temperatures that are specific to the issue at hand. Sometimes the literature is conceptual or outdated.

Other participants identified other types of science needs:

- Program areas differ in terms of data availability. The air programs are data rich, with a national emissions inventory and scientifically peer reviewed models, but other programs, such as the regional pesticide program have little data, models, or mapping tools.
- Science to make GPRA goals and objectives more meaningful - for example, it may be more helpful to evaluate clean-ups by amounts of contaminants, instead of by total pounds of waste. Current enforcement metrics based on reducing pounds of pollutants are not based in science. It would be helpful to have a quick "off the shelf, "science-based approach for evaluating these outcomes.
- Information needs for the regional laboratory include:
    - Tools to identify and track the sources of bacteria and waste identified in storm water and urban rivers.
    - Tools and ability to respond to biological and chemical warfare agents. EPA and the Department of Homeland Security identified warfare agents as a big research gap after 9/11 and Region 1 invested in this area.
    - Polymerase chain reaction (PCR) analysis for addressing beach contamination issue. Region 1 - New England is preparing to use standards and methods being developed by EPA's Office of Water.
    - Endocrine disruptors and pharmaceuticals.
- Ecological effects information related to exposures from aluminum in different pH conditions and the effects on different fish species.
- Information about synergistic effects.

6

- Use of statistics to help identify numbers of samples needed for TMDLs and enforcement monitoring and for analysis of uncertainties in storm water, TMDL, and other analyses.
- Lack of useful Agency hazard information on dioxin, trichloroethylene, hazards of asbestos exposure at contaminated sites

When asked how the Region decides when to undertake a new method or a new scientific capability, the regional managers responded that several processes were involved. Regional managers have ongoing conversations to highlight science needs. In some instances, issues may be vetted through the regional science council, which tries to identify gaps in the regional science. Sometimes new initiatives arise because a regional scientist has an interest in gaining new technical skills or working with ORD. Sometimes the region successfully competes for regional grants from ORD for short-term research needs (as in the case of PCR and now where Region 1-New England now analyzes thousands of samples for the Office of Water nationally). In any case, the region keeps conversation about science needs active and going. The region also checks the Agency's Science Connector to identify activities already ongoing in the Agency.

One manager discussed the nature of public involvement in the NPDES permit process. There is no formal outreach to communities, other than the formal public comment process. EPA must respond to public comments and the response-to-comment documents can be "hundreds of pages long." Policy tends to get made in the permits program by the environmental appeals board, which looks at all the science generated by EPA and the permittee. EPA Region 1-New England has been upheld in three key appeals (the General Electric, Pittsfield, and Attleboro cases), which validated regional science and set precedent for national implementation of NPDES permits for cooling water intake.

In response to a question about nutrient criteria, a regional manager acknowledged that Region 1 New England currently takes a site-specific approach. His program translates current narrative criteria by modeling the water system, measuring inputs, considering biological endpoints (i.e., deposition into sediments, biota, and local conditions) and then back calculates, based on the particular river system, to identify a permit level for the discharger. The Region takes the narrative standard and uses best professional judgment to develop something enforceable and numeric. He noted that the proposed national numeric criteria were a "double-edged sword." It would be difficult to develop national numeric criteria sensitive to ecoregions and other factors, but the current approach does rely on using best professional judgment to interpret non-numeric, narrative standards. Some regions may not have the scientific infrastructure and protection of scientific integrity to ensure enforceable science-based standards. There are currently a "huge range" of nutrient limits set across the ten EPA regions.

Another manager discussed the region's use of quality assurance to support efforts across the Region. His division not only conducts audits, but also works with offices to identify sampling and quality assurance issues at the start of projects. His office has used guidance from EPA's Council for Regulatory Environmental Modeling and international modeling guidance. His office focuses on initial development of a quality assurance plan, uncertainty analysis, criteria identification, and then determination of whether data quality objectives have been met and if regional analyses need iteration. The goal is defensibility and his office asks "did you

document and did you have a rationale for your science conclusions." His organization tries to bring more transparency and up-front thinking to EPA's analyses.

A manager discussed the importance of Integrated Risk Information System (IRIS) numbers. The region follows the OSWER guidance on the hierarchy of human health toxicity values when performing human health risk assessments. According to this guidance IRIS values are used if available. Where IRIS values are not available, PPTV values if available are used. If neither IRIS nor PPTV values are used, other available peer reviewed toxicity values are used. The manager indicated that up to date IRIS values would be preferable. An SAB member asked if IRIS values are used "even if out of date". The response was that the above-mentioned guidance document is relied on when determining appropriate toxicity values.

The group noted that the region has developed a level of comfort with decisions based on uncertain scientific information. Regional scientists and managers realize that no two environmental data sets tell you the same thing. Through multiple discussions, regional scientists and managers communicate with each other about what is known with certainty, where the uncertainties exist, and have developed ways to communicate decisions and their rationales contingencies, and uncertainties to the public. It is often a difficult and dynamic situation for those who explain decisions and uncertainties to the public. Some stakeholders are comfortable with uncertainties; others less so.

In response to a question about cumulative risk assessment, a manager noted that EPA generally does not conduct any sort of cumulative risk assessment other than a hazard index approach to address chemical risk from a site. Many communities ask about cumulative risk, however, beyond that information, for example, the contributions of air exposures or childhood asthma in combination with site risk.

SAB committee members asked about the region's use of social science in understanding demographics and for targeting communications. Managers responded that the region had community involvement coordinators who conduct workshops, are good facilitators, and carefully plan community-based work, but that the region had very limited social science capability. They also voiced concern about administrative barriers to conducting social survey research as a result of Information Collection Request requirement and the requirements of the Federal Advisory Committee Act. A measure of success of community engagement is when members of the public stand up to congressionals" and when community thinking on an environmental issue "moves to a better place."

In response to a final question from committee members, a participant noted that the region does address science needs for tribes. One example is a study underway to assess the risks from pollutants in in a river system used by the Penobscot tribe members for both sustainability and cultural practices.

Interview with EPA Region 1 New England Scientific and Technical Staff
October 28, 2009, 1:30-3:00 p.m.

EPA Region 1 New England Participants:

Mr. Marcel Belaval, Hydrogeologist, Drinking Water Branch, Office of Ecosystem Protection (OEP)
Dr. Alison Simcox, Environmental Scientist, Air Programs Branch, OEP
Ms. Ellen Weitzler, Environmental Engineer, Water Standards Branch, OEP
Dr. Rhona Julien, Environmental Scientist, Air Programs Branch, OEP
Dr. Raymond Putnam, Ph.D., Toxics and Pesticides Unit, Office of Environmental Stewardship (OES)
Mr. William Lovely, Environmental Engineer, Office of Site Remediation and Restoration (OSRR)
Ms. Sarah Levinson, Assistant Regional Manager, Office of Regional Administrator
Mr. Robert Hillger, Regional Science Advisor – ORD Liaison
Mr. Todd Borci, OES (water quality enforcement)
Dr. Dwight Peavey, OES (EPCRA enforcement)

SAB committee members asked participants to identify the types of science-based decisions made in their organization and their roles and invited them to address questions in the committee's *Preliminary Study Plan*.

The first participant worked on water quality standards and noted that the "most useful science for us is science that translates into regulatory action." A good example was state-specific copper criteria, where EPA has developed easy to use models. In contrast, mercury criteria still need work. There is some on-going controversy with regards to risk if you use fish tissue criteria as opposed to water quality criteria. EPA made the change because fish tissue involved the "strongest science," but fish tissue data are expensive and time-consuming to collect. There was the potential of leaving the states with no operable criteria at all, but a national policy was issued to "use what you have until you have fish tissue data." For Massachusetts and New Hampshire Water Quality Standards, where Region 1-New England writes permits, the region "looks high and low for research outside and inside EPA." The region puts ORD "RARE" money "to good use."

The next participant described science in the regional Superfund program, which has well-defined processes and types of decisions. The Superfund has "very efficient process following national criteria." In the program, regional staff engages the public, develops site conceptual models, and data quality objective. Superfund processes are well implemented.

Science needs for the Superfund program include:

- Numeric criteria, action levels and action levels for ecotoxicity.
- Action levels for subchronic exposures: the public asks "Is it safe for us to be out there when I see you in Tyvek suits." In response, "We do back of the envelope estimates," but it would be better to have science-based estimates.

- Asbestos criteria for percentage of fiber in materials.

He spoke both of the need for more specific action-oriented levels for regulation and more easy access to information that may be available.

The next participant spoke about his work providing states with assistance reviewing their assessments for clean-up. His scientific contribution involves a strong knowledge of scientific tools and field methods. Although he is not conducting research, he can assess whether methods and techniques are chosen appropriately and used correctly. He also, as a hydrogeologist, is involved in "bigger picture issues." He is often involved in regional water planning, i.e., water availability in aquifers that may be potentially impacted by climate change, looking at what data are available or under way, how can that data can be used by town planners. He looks to identify regional studies that may be needed.

From his perspective the biggest science gap is "applied knowledge of different investigation types and whether they are used well or not." In his work, he collaborates with state hydrogeologists, town water system operators, watershed groups, and the U.S. Geological Survey. EPA itself has few experts who focus on hydrology related to drinking water issues.

Next, a regional scientist spoke about his work on water enforcement related to surface water quality. He focuses on municipalities that discharge above certain level and supports decisions on enforcement levels. His work involves complex interpretation of data from many studies. From his perspective, there is little practical consistent guidance. Most research seems unrelated to practical environmental protection needs. Federal agencies such as ORD and USGS seems to be doing a lot of "sophisticated pharmaceutical work," but not helping regional scientists test for the most cost-effective set of pollutants from multiple output pipes. He called for science to "get back to basics" and use scarce resources for the most urgent and practical environmental protection research needs.

Another scientist added that regional scientists need more than just additional tools. They need help with evaluation of external science. Published literature is "out there but it is passive." The question is "how do you apply it to a practical problem?" Such questions shouldn't be left to the end user. EPA is different from industry, where "industry identifies a problem and then develops research to inform that problem. It doesn't work that way at EPA."

Yet another scientist spoke about the need for EPA to address some strategic science issues. He noted that EPA's legal framework requires the Agency to focus on selected chemicals, where there are other chemicals of greater concern, supported by "irrefutable data." He spoke of "missed opportunities" to focus on chemicals that bioaccumulate. The limitations of the Toxic Substances Control Act mean that "chemicals get out there and may have huge environmental problems" that need attention. He spoke of the need to address pharmaceutical chemicals and motivate industry and communities to reduce use of toxics, as EPA effectively did with chlorofluorocarbons.

A public health scientist spoke of EPA's difficulty in communicating integrated science with the public. Although Region 1-New England finds it relatively easy to integrate science for

decision making internally, the region "gets stymied" in the public arena, where politics and policy, and public participation get more complicated. It is much more difficult to confront science issues in a public arena. When asked whether the Region talks to communities or public to understand their perspective and values before it talks to them about science, she responded that often the Region finds that science may not be aligned with public perceptions.

The next scientist provided the Designated Federal Officer with written responses to the questions in the committee's *Preliminary Study Plan.* She spoke of her experience in the RCRA, TMDL, and air programs. She noted that the air program had a relatively "controlled process" for using science. The Clean Air Act prescribes development of National Ambient Air Quality Standards (NAAQS) for the six criteria air pollutants and requires them to be reviewed every five years. The law requires identification of attainment/non-attainment areas, and requires states to develop State Implementation Plans in non-attainment areas. As a regional scientist, her priority is to work with states to meet deadlines within those processes and she is "constantly aware of legal risks." As a result, there is a "tendency to go with what works -- what has passed muster legally and to ensure consistency across regions." EPA must make the process defensible in case EPA goes to court. She participates in national workgroups that set NAAQS for fine particles and also works with ozone.

She also is working on the SPARROW model to predict mercury levels in fish tissue at fine scale. This MERGANSER model involves a research team and represents a major Region 1-New England achievement. She commented that in the region, "a lot of what happens depends on a person's interest."

The regional scientists then briefly discussed frustrations finding the best science, given legal requirements. When asked whether the region ever finds that the "best science is yet unproven and unaffordable," several participants responded that the best science is "science which our resources allow us to use and retains legal defensibility."

The final scientist drew on her background in public health and Superfund. In her view, the Superfund program does an excellent job of integrating science in every decision. It brings together diverse groups of specialists (e.g., hydrogeologists, health and ecological risk assessors, community liaisons). It sustains an open dialogue on major questions--it gives everyone an opportunity to speak and raise questions about the decisions on the table. The challenge for managers is managing uncertainty at all levels. Managers must understand "how confident are we about what the contamination is, how hazardous it is, where it's going." No matter how much analysis is conducted, EPA struggles with managing uncertainty because decisions must be made in a certain timeframe and EPA does not have the luxury of long-term research.

She noted, however, that regional science is not perfect. Some decisions can be made by one individual (e.g., how many samples to obtain) and maybe not represent the best science all the time.

A committee member asked about the region's processes for managing uncertainty. The scientist responded that techniques employed by the region generally rely on a group dialogue, bringing people with diverse backgrounds and different perspectives together. She noted that

managers rarely ask technical staff to present quantitative estimates of uncertainty. Although regional scientists have access to Monte Carlo tools and other statistical analyses of uncertainty, often staff have only 15 minutes for a presentation and "we don't put error bars on our estimates." Monte Carlo techniques are rarely used or asked of specialists. She noted that in many site-specific analyses, the stakes may not justify such sophisticated techniques, unless the Region is "up against" a sophisticated Potentially Responsible Party that is challenging each exposure assumption. Another regional scientist observed that technical uncertainty analyses would be difficult for the public to understand.

Both scientists noted that the region focuses on each decision as making incremental improvement. "We don't need 100% certainty or perfection – but we do need to get over a threshold to get to the next level of environmental protection." There is a management process that may include a discussion of uncertainties. The region does not conduct the type of sensitivity analysis recommended by the 2009 National Research Council Report *Science and Decisions*, which calls for an examination of the implications of different assumptions. Often EPA does not have the luxury of time or the liberty to do such analyses.

The regional scientists talked briefly about public involvement. They recognized the importance of involving the public "up front." The Superfund program has mechanisms for soliciting and incorporating input. One scientist observed that the region could do a better job of involving the public up front more generally and for developing mechanisms that are efficient and effective.

The scientists concluded the discussion by identifying gaps in the region's science capabilities, barriers to science integration, and needs. Points discussed include:

- Hiring statisticians to help identify areas of contamination and summarize environmental sampling results.
- Hydrogeologists.
- Focus on bean-counting can frustrate science integration(e.g., the need to generate TMDLs vs. focus on strategic needs that may be presented by pharmaceuticals and personal needs products, a focus on bean counting rather than holistic public health protection).
- Scientist burn-out. Regional scientists sometimes find that needed science can only be generated on their personal time or with extraordinary effort.
- Losing staff to retirement, institutional knowledge, cut backs in training. Generalists need access to specialists to make informed decisions.
- Limited resources.
- More agency wide commitment to applied science.
- More research focused on hazard assessment.
- Need for examination of, if and how EPA receives feedback on past decisions using science. Such analysis could provide an opportunity for managers to revisit past decisions to see how science was used and may provide insight for how science could be used more effectively in decision making in the future.

EPA Region 2 Science Integration for Decision Making Fact-Finding Interviews
December 17, 2009
290 Broadway, New York, New York

Three members of the SAB Committee on Science Integration for Decision Making conducted three interviews in EPA Region 2: Drs. Jill Lipoti and Wayne Landis in person and Dr. Thomas Theis by telephone. For each interview, Dr. Vanessa Vu, Director of the SAB Staff Office, provided a brief introduction to the purpose of the interview and the Designated Federal Officer, Dr. Angela Nugent, took notes to develop a summary of the conversation. All interviewees were provided a copy of the committee's Preliminary Study Plan in advance.

Dr. Vu noted in each interview that the purpose of the interview was to help SAB Committee members learn about Region 2's current and recent experience with science integration supporting EPA decision making so that the SAB can develop advice to support and/or strengthen Agency science integration efforts. Dr. Vu thanked participants for taking time for the interviews and thanked Drs. Marian Olsen and Roland Hemmett for serving as liaisons with the SAB Staff Office in planning the interviews. Dr. Hemmett preceded the interviews with an overview of distinctive features of Region 2.

EPA Region 2 Manager Participants (10:15 - 11:45 a.m. Session)

Division of Environmental Planning and Protection
- Barbara Finazzo – Director
- Doug Pabst – Leader of the Dredging Sediments and Ocean Team
- Jeff Gratz – Chief of the Clean Water Regulatory Branch
- Phil Sweeney – Chief of the New York City Water Supply Protection Team

Emergency and Remedial Response Division
- Walter Mugdan – Director
- Doug Garbarini – Chief of New York Remediation Branch
- Ray Basso – Strategic Integration Manager, Chief of the Passaic River Study
- Vince Pitruzzello – Chief of the Program Support Branch

Managers described how science is a major factor in Region 2's dredging program and how it often points to costly risk management options that conflict with economic needs. Science is definitely a focus of stakeholder attention. Region 2 managers voiced concerns about implementing EPA's peer review policy. Although it is important to comply, peer review is often costly in terms of resources and time. It is often not clear what type of peer review is needed or how to frame peer review questions appropriate at a given stage of a project. It is difficult to fit peer review into EPA's regulatory schedule. At times, peer review seems to become a science project with a life of its own. Sometimes, peer reviewers provide "an academic view" that EPA should develop more data, when an EPA manager has a timeline to make a decision based on available data.

Managers reflected on the challenges involved in managing the peer-review process. One approach used by Region 2 for peer review in the Superfund process when there are

contentious issues is to arrange for a third-party neutral to select peer reviewers from a list of experts proposed by EPA and the principal responsible party. Because the Superfund program, is adversarial, the potentially responsible party hires expert consultants who challenge EPA's science. When the process works well, robust science results from the contentious process.

The dredging program also involves "dueling science" related to contaminated sediment in the New York-New Jersey Harbor. Region 2 has a strong relationship with ORD and the U.S. Army Corps of Engineers' Waterways Development Center at Vicksburg on science relating to dredging. A long history of industrial development has contaminated sediment in Region 2. Ocean dumping of contaminated sediment had been the default solution, but now environmental groups are challenging this option. Because science allows detection of pollutants and adverse effects at increasingly lower levels, EPA must engage scientists and the public in determining "how clean is clean" and convince the public of the wisdom of any sediment clean-up decision.

An impediment to the use of science arises, however, because regulations can't keep up with science. EPA's decisions need to follow the law and implement regulations. The Marine Protection, Research, and Sanctuaries Act (MPRSA), also known as the Ocean Dumping Act, prohibits the dumping of material into the ocean that would unreasonably degrade or endanger human health or the marine environment. A team of oceanographers in Region 2 may help identify options for disposal of dredging material, but the public, including environmental groups, must be convinced that EPA is following the law.

Region 2 has taken several approaches to engaging the public and different factions of dueling science on the sediment issue. One approach was to involve over 1,000 stakeholders in a "United Nations" approach that involved too many groups and individuals early in the development of the science and policy options. Because of the complexity and controversy, that approach did not work well. Currently, peer review is the principal mechanism for reconciling dueling science. Region 2 has followed EPA's peer review process and negotiated charge questions with groups interested in or affected by the sediment issue. In one case, the contentious process for negotiating the charge was highly structured and took four years. Seven years later, EPA and the Army Corps of Engineers received the peer review and conducted the additional studies that peer reviewers identified as necessary to strengthen the science assessment. The Corps invested millions of dollars in studies. They attached radio transmitters on fish to monitor fish movements around sediment. They generated a robust data set that would support a probabilistic risk assessment, as recommended by reviewers. But, as new studies were published and data become available, the studies and data received additional scrutiny and challenge. Peer review did not provide protection from challenge.

Another example, from another program, was a variable introduced into a sediment transfer model being used in the Passaic River to evaluate current and future sediment and fish tissue concentrations. The peer-reviewers identified a specific variable to be included in the model. After two years invested in running the model with this variable sediment experts decided that the variable used was incorrect.

Ideally, managers would like Ocean Dumping Act regulations to allow more flexibility to work with available scientific information. Court rulings, however, have determined that EPA

must change regulations to achieve the flexibility desired. Exercising discretion, without explicit legal justification, raises public concerns about trust and a fear that EPA may be "tilting toward economic interests."

. Region 2 does not have economists on staff to help put a value on clean sediment and did not know if "EPA has economists" the Region could tap to help address this issue. The contaminated sediments reduction program may ultimately cost $20-30 million. If the benefits were clearer to the groups involved, some of the contentious issues could "go away."

Peer review also plays a role in the Superfund Program. Remedies over a certain threshold go to EPA's Remedy Review Board for evaluation. Sometimes issues go to EPA's Contaminated Sediment Technical Advisory Group for review. The state also reviews remedies.

The Superfund Program has a structured assessment process that follows national regulations and guidelines. The program uses Integrated Risk Information System (IRIS) as a basis for toxicity values. IRIS values may sometimes not be based on the latest studies, but they are based on studies that are robust and well understood and extensively peer-reviewed.

The Superfund Program involves consideration of economics within the framework of cost-effectiveness within the nine evaluation criteria for Superfund remedial alternatives. Superfund charges EPA with developing a cost-effective solution. Region 2 evaluates effectiveness of remediation mechanisms and seeks to identify a less-cost approach that meet the threshold criteria of protection of human health and the environment and compliance with applicable or relevant and appropriate requirements.

Although the Superfund Process is highly structured, there is a "huge discretionary element at the tail end," because solutions must be human-health protective within a two-order-of-magnitude range, i.e., 10^{-4} to 10^{-6} range for cancer and also a Hazard Index equal to 1 for non-cancer. That range allows risk managers discretion to address social and economic issues as part of the nine criteria for evaluation of Superfund remedial alternatives. A manager noted that many public and technical controversies revolve around risk and exposure assessments (e.g., technical issues of whether an exposure assessment details whether typical exposure involves eating "fish with the head on" or "how often an individual eats fish from a contaminated waterbody"). It may not make sense to invest in the additional science to such a detailed level, when remediation decisions can be made in the 10^{-4} to 10^{-6} cancer range and a non-cancer Hazard Index equal to 1.

Other managers agreed that additional scientific precision often is not useful to managers and sometimes introduces complexity difficult to understand. Experts often disagree on technical issues and it is difficult to communicate the results of a complex model with many uncertainties to the public. One manager noted that the air program used a well-established approach for managing change in models over time; such a program would be useful for models in the Superfund and sediment management programs

Region 2 relies on science generated outside EPA to support many decisions. Managers rely on highly trusted local colleges and universities for specific expertise, such as Manhattan College and on relationships with other federal agencies. They also evaluate and use science generated by Potentially Responsible Party(ies) and their contractors. Region 2 managers did not view EPA scientists as national experts in some technical fields related to their programs (e.g., sediment modeling), compared with EPA's high level of expertise in air quality and modeling, which is recognized nationally and internationally. Region 2 receives some support from ORD's sediment/fish modeling experts in Athens, Georgia, but needs more technical support than those experts can provide based on resources and time constraints. Region 2 managers observed that their decisions depend on complex sediment modeling, which is difficult to evaluate, given EPA's current expertise.

Managers noted that EPA traditionally relies on principles to interpret exposures if Agency scientists can't quantify risk (i.e., if EPA has no toxicity value). One manager wanted robust science that fully characterizes a problem to the extent possible so he will have flexibility to make the best management decision. The key question for him is whether it is worth investing billions of dollars in cleaning up the Passaic River. If the river will clean itself in ten years, such a cost would not be worthwhile. He needs to consider available science related to sediment transport and human and ecological risk to help him make the decision. Data provided by discharge permittees, ambient monitoring data, and data to develop Total Maximum Daily Loads are used to check models and also provide information that feed into his decision.

A manager briefly described science integration for dredging projects less controversial than the Passaic River site. For most sites, project managers coordinate with the U.S. Geological Service, Fish and Wildlife Service, and the Agency for Toxic Substances and Disease Registry of the Centers for Disease Control and Prevention. Technical documents receive internal review, inter-agency review and where appropriate external peer review. Science integration impediments involve limited budgets for sites; potentially responsible parties that contest Agency science; and differing scientific interpretations across federal agencies working on a single site.

Region 2 managers described mechanisms to collaborate with ORD. The Superfund Program has an ORD technical liaison, who helps remedial project managers contact ORD laboratories. Region 2 has a special relationship with ORD's Narragansett and Gulf Breeze laboratories and holds weekly calls with those laboratories. Region 2 managers praised a recent technical workshop on storm water science issues organized by Region 1 and ORD, because it provided a valuable opportunity to exchange scientific information. Region 2's risk assessors work with ORD's National Center for Environmental Assessment, a source for exposure factor information and IRIS toxicity values and with other portions of ORD where appropriate. Regional scientists also coordinate with other regions and coordinate with the Agency's science Policy Council, Office of Science Advisor, and Risk Assessment Forum. Regional scientists also work with the Regional Science Liaison to identify resources within ORD.

Several managers described science integration for watershed protection. To protect the New York City watershed, Region 2 and other stakerholders work with Cornell University to promote agricultural practices that protect against pathogens and phosphorus runoff. Region 2

seeks to demonstrate effective strategies, such as waterfowl management, that protect watersheds in a cost-effective way. Where scientific data can show dramatic improvements in source water quality, science can help persuade people to participate in voluntary programs.

A manager mentioned planning for the future of land acquisition in the Catskills to protect the New York City watershed. Although a land acquisition program has protected the watershed in the past, it is unclear how much land acquisition will be sufficient for the future, and local communities want economic development and are resisting additional purchases. Region 2 could use a stronger base of science to help establish a reasonable threshold.

Managers discussed human resource needs related to science integration. To attract new scientists, Region 2 has used a student career employment program that allows the Agency to hire University students who work for 600 hours per year as they study for their degree. One student in this program obtained a doctorate. To date, three students have completed this program and are working as risk assessors in the region. Managers have also taken advantage of the current economy to hire fairly well-trained new employees. Region 2 does not currently have a comprehensive succession plan. The age of the workforce differs across programs in the region because of different historical hiring patterns. Funds for travel and training are limited. Managers are able to send staff to a minimum of one professional scientific conference per year. Managers provide training funds for college courses and professional development. They complimented the region's scientific speaker series. In addition, scientists are able to attend webinars, conference calls, etc. that are organized to provide training on specific scientific issues.

Managers acknowledged a need for more training and orientation to products and technical tools developed by ORD. Although some ORD programs provide strong technical support, there is no consistent approach to technical support for regions.

Discussion with EPA Region 2 Deputy Regional Administrator, George Pavlou (1:00 - 1:45 p.m. Session)

The Deputy Regional Administrator began the discussion by noting his pride in the caliber of Region 2's scientists, their commitment to the region, and their interest in learning the latest science. He also expressed pride in the region's scientific work products. Science permeates Region 2's activities and is a major focus of public meetings. In some ways, the science supporting decisions is the "easy part," compared to other factors.

He described a recent issue involving polychlorinated biphenyls (PCBs) in caulk, where he has developed an agreement in principle with the City of New York. PCBs have been used historically to make caulk malleable, but regulations under the Toxic Substances Control Act (TSCA) require that materials that have PCBs that exceed 50 parts per million (ppm) must be removed.

After PCBs were identified in caulk and local media focused on the problem, nine schools tested their caulk and identified PCBs over 50 ppm. The city took remedial action at those sites and the Parents and Teachers Association began to sue the school system.

As a decision maker, the Deputy Regional Administrator found himself in a quandary. Regulations require PCB removal, but PCB removal is very expensive and New York City schools have major budget issues. There is no requirement for testing, and even if PCBs are found, removal of the caulk may cause additional risks if not conducted appropriately. Nevertheless, members of the public pressured him to require the school system to conduct tests.

To make a more informed decision, he decided to defer decisions on testing caulk until the region and the public understood the overall context for PCB exposures (e.g., whether there are PCBs in floor tiles, or fluorescent lights) and were convinced that there was an unacceptable risk. The school system conducted air sampling and Mr. Pavlou consulted with Region 2's risk assessors about a "safe" level for cumulative exposures to PCBs, which was identified as 400 micrograms per cubic meter, and also consulted with ORD about PCB detection technology. He took a Superfund-site approach, rather than a strict regulatory approach based on TSCA. He defined the problem, defined options, and then is moving to implement a solution. In his view, "science opens the door, helps the decision maker to frame questions, and get solutions." Science may even help to identify options that may not even exist within a specific regulation.

For the caulk issue, Mr. Pavlou intends to sign a "precedent setting agreement," which requires the school system to test five sites for PCBs in the air, caulk, and other media. He hopes that it will become a model approach, because risk management cannot ignore socio-economic issues, and regions must address emerging issues in a practical way.

He noted that such a complex and precedent-setting decision should be made at a senior-level, such as the level of Deputy Administrator, after consultation with peers in the Office of Solid Waste and Emergency Response (OSWER), ORD, and enforcement, and after elevating the issue for the Administrator's attention. Where science is not available, as in the case of the World Trade Center catastrophe, where there was no science indicating a safe return level or safe clean-up level, EPA must make the best decision it can, knowing that science will evolve.

In some cases, regulations do not give decision makers flexibility to make decisions based on science. TMDLs based on EPA-accepted state water quality standards for PCBs, for example, require facilities to reduce wastewater discharges to concentrations of parts per quadrillion. Technologies don't exist to reduce discharges to that level and even if discharges were to be so reduced, PCBs from other sources could re-contaminate the waterbody. Companies may now file suit because of these science issues, but if Region 2 sets policy based on the science and allows greater PCB discharge, environmental groups might challenge the alternative approach.

Mr. Pavlou spoke of barriers to science integration. He called for resources for more risk assessors so that programs beyond Superfund could have better access to science. He called for reassessment of priority chemicals with attention on children and vulnerable populations.

He also noted that it may be useful for the region to have more social science to inform policy. Risk managers need flexibility and decisions could be enhanced by analyses showing justification for taking socio-economic factors into account. He also acknowledged the need to represent tribal issues and tribal perspectives and the difficulty of factoring their concerns into

ecological risk assessment and climate change decision making. It may be helpful to engage social scientists to work with these concerns. He noted that he has asked tribes to consider ways they could monitor climate change impacts that would reflect their values and traditional knowledge, such as monitoring changes in growth of reeds used for basket weaving.

EPA Region 2 Technical Staff Participants (2:00 - 3:30 p.m. Session)

Division of Environmental Planning and Protection
- Clean Water Regulatory Branch
  - Doug Pabst – Leader of the Dredging Sediments and Ocean Team
  - Mark Reiss – Dredging Sediments and Ocean Team
  - Wayne Jackson – TMDL Standard Team
  - Rosella O'Connor – TMDL Standard Team
- Watershed Management Branch
  - Mark Tedesco – Long Island Sound Office
  - Rick Balla – New York Watershed Management Section

Emergency and Remedial Response Division
- Jon Josephs – Superfund and Technology Liaison
- Marian Olsen – Program Support Branch

Division of Environmental Science and Assessment
- Marie O'Shea – Regional Science Liaison

SAB members asked scientists to describe the decisions made in their programs and their role in those decisions. A risk assessor described his role in the sediment program, where he received "on-the-job training." The Superfund and Technology liaison described how he worked to advise ORD about regional needs. Another scientist described the Peconic Estuary Program and his role in synthesizing information related to atmospheric deposition, non-point source impacts, land use, and agriculture. He spoke of the need for social science to improve nonpoint source management and pollution prevention (e.g., reducing use of fertilizers on lawns).

Other scientists spoke of the wide variety of models used in the TMDL programs. Some have few data and simple models, while others are data and model intensive and receive a high level of scrutiny from citizen's groups and regulated entities. In setting TMDLs, water quality standard coordinators work with the Office of Water, states, tribes, and regional staff needs and to provide regional staff with scientific and technological information needed to support decisions. However, some of the information may not be as current as one would like.

Several scientists voiced frustration with peer review, which they had noted had been viewed as a "panacea to give us cover for our science." They noted that peer reviewers often provided comments from an academic perspective and sometimes provided comments that led the region away from safe, proven scientific areas. Occasionally, as with ecological assessments designed to support a sediment decision, peer reviewers "pushed" the region toward "overly elaborate models that did not contribute to decision making.

One scientist emphasized the importance of stakeholder involvement in developing EPA's science. Stakeholders often do not want to hear "some of the elaborate model outputs

peer reviewers want," He suggested that EPA should invest more in building public understanding of the limits of the data. EPA "can't hide behind peer reviewers." Scientists from the estuary program noted that they involve stakeholders during problem formulation and scoping in problem identification and study design. Scientists working with the dredging program, however, took a different view. In their contentious program, "you can't show a chink in your armor," but such an approach makes it difficult to "tweak and adjust" science.

Scientists expressed the desire that ORD provide very fundamental types of data on chemical hazard, rather than sophisticated models and genome effects, which do not provide a basis for regulatory decisions. An interviewee noted that regions find it difficult to fit into the ORD research planning process.

Region 2 interviewees were aware of ORD's ecosystem services research. They noted that there is currently no ORD Region 2 project on ecosystem services and overall a limited budget for ecosystem service research. Several scientists spoke of the potential value of such an approach for the New York City watershed and of interest in the Delaware Bay. Scientists noted that Region 2 had conducted a study of ecosystem services related to the Peconic Estuary 15 years ago. At that time, the ability to quantify services was data limited, because the region lacked local information about how land-use decisions were made. Members spoke about the important impacts of nutrients on coastal watersheds and the need to strengthen the science to understand non-point sources of pollution. There is a need to understand development density and intensity, alternative land-use options, and how people make land use decisions. Social science is a key to understanding land use, changing personal and community behavior, and social-base marketing. For problems where there are no regulatory tools, social science needs to become part of the management approach.

Scientists noted several barriers to science integration supporting decision making. Decision makers depend on updated science assessment and risk numbers. Although it is a labor intensive process to develop the assessments, important clean-up decisions depend on those assessments and should be made on updated values reflecting the best, most current science. There is also a need for ongoing processes to approve analytical methods, so EPA is not limited by using outdated methods. The region also needs modeling staff to run regulatory environmental models. Currently, the region depends on contractors to run many important models and to evaluate modeling provided by Potentially Responsible Parties. Several regional scientists suggested that ORD provide centers of excellence for modeling support.

Scientists noted that Region 2 provides "fair to good" support for travel and training for professional development. The challenge for regional staff is to find time for training. Several interviewees noted the value of technology-based training, such as Clu-in, where Region 2 scientists do not need to schedule several days or a week away from work. Although such electronic training does not provide the same kinds of opportunities for networking and personal interaction as a conference, it can be very useful.

EPA Region 3 Science Integration for Decision Making Fact-Finding Interviews
January 19, 2010
1650 Arch Street, Philadelphia, PA

Four members of the SAB Committee on Science Integration for Decision Making conducted three interviews in EPA Region 3: Drs. Thomas Burke and Taylor Eighmy in person and Drs. Deborah Cory-Slechta and Thomas Theis by telephone. For each interview, Dr. Anthony Maciorowski, Deputy Director of the SAB Staff Office, provided a brief introduction to the purpose of the interview and the Designated Federal Officer, Dr. Angela Nugent, took notes to develop a summary of the conversation. All interviewees were provided a copy of the committee's Preliminary Study Plan in advance.

Dr. Maciorowski noted in each interview that the purpose of the interview was to help SAB Committee members learn about Region 3's current and recent experience with science integration supporting EPA decision making so that the SAB can develop advice to support and/or strengthen Agency science integration efforts. Dr. Maciorowski thanked participants for taking time for the interviews and thanked Mr. Stuart Kerzner for serving as liaisons with the SAB Staff Office in planning the interviews

EPA Region 3 Managers (9:00 a.m. - 10:15 a.m. Session) Participants

Mr. David Arnold, Director, Air Protection Division,
Mr. Jon Capacasa, Director, Water Protection Division
Mr. John Armstead, Water Protection Division
Ms. Vicky Binetti, Water Protection Division
Ms. Healther Grey, Office of Regional Council
Ms. Cathy Libertz, Office of State and Congressional Relations
Mr. John Krakowiak, Office of Policy & Management
Mr. Wayne Naylor, Land and Chemicals Division
Mr. Abe Ferdas, Land and Chemicals Division
Mr. Larry Teller, Public Affairs,
Ms. Kathy Hodgkiss, Hazardous Site Cleanup

A regional manager began by emphasizing that regions focus on implementation and enforcement of programs developed by national program offices. Science integration opportunities can be "intense" in new and emerging areas where the path "isn't well worn" and science is needed to inform policies. Science plays an important role in decisions in the Chesapeake Bay program and mountain-top mining. There are usually separate forums that provide input on policy and science issues to decision makers.

Managers addressed the unique aspects of regional work that present science integration challenges. One manager described how Superfund and RCRA "clean-up programs" depend on EPA's ability to absorb new science. The Integrated Risk Information System (IRIS) lags seven years behind schedule and, as a result, Potentially Responsible Parties (PRPs) can integrate new science into their site assessments in some cases when EPA regions can not. He expressed the desire for EPA's assessment programs to "absorb and digest" new science in the IRIS and Office

of Water Maximum Contaminant Level (MCL) programs. Currently, the public is aware of new scientific findings and "blames EPA" for not basing clean-up decisions on recent science. The lag in integrating available science into regional decisions creates a transparency issue difficult for regions to address. Vapor intrusion and trichloroethylene are key examples.

Another example of science integration at the regional level for clean-up programs involves ecological effects. Region 3 does have an active Biological Technical Administration Group (BTAG), with participation from the National Oceanic and Atmospheric Administration and Fish and Wildlife Service. There are, however, no standard procedures for ecological clean-ups. Sediment data on the Anacostia River show ecological effects at levels where there are no human health effects, but clean-ups are costly. There is a "significant feeling that we should be doing something" but no clear guidance for integrating the science.

Emerging challenges identified by science create another kind of science integration issues. Region 3 needs to address total dissolved solids related to mountain top mining and their impact on the environment. The region must take science-based action to address water quality problems created with drilling for natural gas in Marcellus Shale. EPA needs programs to address water quantity problems, to determine the "proper amount of flow." These issues do not fit easily into EPA's current regulatory programs. The region looks for opportunities across all EPA programs (regulatory and non-regulatory) to address problems.

The region has a complicated relationship with its states on these issues. For some issues, scientific findings seem to threaten important industries in a state. In other cases, EPA can fund state research (e.g., for source tracking of mercury, exposure assessments) that lead to a good dialogue with states and stakeholders). Sometimes a state leads in use of science in a program (e.g., Pennsylvania's Brownfield Program) and is an example for other states.

Region 3 managers expressed appreciation for the ORD Regional Science Liaison position, which enhances communication with ORD. The region also supports an internal regional science council, participates in the Regional Applied Research Efforts (RARE) and collaborates with ORD in sponsoring forums with states and academia (e.g., on connectivity, total dissolved solids, and climate change) that provide a science foundation for the region's work.

Region 3 also uses the Multicriteria Integrated Resource Assessment (MIRA) decision science model and related logic model. Region 3 developed MIRA to support air rulemakings, especially for attainment decisions. Region 3 develops more rulemakings of this type than other regions. MIRA helps Region 3 integrate multiple levels of data through indexing data for comparisons and explicitly incorporating human preferences. To develop MIRA, Region 3 had a scientist expert in the analysis, a policy context where the decision-science approach was needed to integrate multiple kinds of expertise, and managers who were "comfortable and confident" enough to use the new tool. Managers noted that MIRA has also proved useful in explaining EPA's decision and supporting rationale to the public.

Region 3 managers expressed a need for a balance of scientists with backgrounds in physical science and engineering (especially for the air program), Environmental Protection

Specialists, and social scientists. Managers voiced concern that the federal Government's new hiring procedures created artificial barriers to hiring people with the kinds of expertise and training needed. Many excellent candidates want to work for EPA, but the hiring process makes it difficult to select them. And, where there are new personnel, an increasing number remain at EPA only for a short time, creating continuity problems. The region's laboratory has programs hiring scientists with the high level of expertise needed for analytical work. Managers noted that regional scientists are knowledgeable and nimble enough to work on problems as they arise, but Region 3 does not have all the expertise needed and often has to "search hard to get support from ORD." Region 3 managers noted that ORD often hires scientists, who, even though they are "terrific scientists." do not want to "do the applied science regions need." Rather, there is often a conflict between ORD's obligation to do more basic vs. applied science and ORD researchers don't get the encouragement/support for applied science.

One manager observed that "often ORD isn't even in the picture, can't move fast enough" to meet Region 3's science needs. Managers discussed the possibility of ORD scientific "Tiger Teams" to help regions meet challenges and provide the best science. A model might be the Superfund Rapid Response Team. Region 3 managers noted that these teams form at the regional level.

Managers discussed the next challenges facing Region 3. The most urgent is Marcellus Shale, which involves subsurface gas drilling and hydraulic fracturing formations to extract natural gas in the Appalachians. The Appalachians offer a huge reservoir of natural gas, close to population centers. Region 3 used the Logic Model and MIRA to integrate information for problem formulation, is convening key offices at EPA to identify knowledge gaps, and is involving other federal agencies and states to discuss the problem and how to address it. This urgent issue has no research program supporting it, but yet are key science and research questions involving connectivity criteria, total dissolved solids, toxics from fractive fluids, and water quantity.

Another important issue involves sustainability and material management. One manager spoke of the need to develop the field of lifecycle analysis.

Managers concluded the meeting by discussing impediments to science integration and discussing the impacts of guidance received from the National Research Council and SAB. Needs include:

- Monitoring data on human health and environmental impacts, especially for groundwater quality and soil.
- Guidance from public affairs offices about communicating uncertainties to the public. If EPA scientists have conflicting data or interpretations, how transparent should communications be about these "less-than-perfect decisions?"
- Guidance on risk communication. Complex risk assessments for well-studied chemicals, with multiple endpoints and data susceptible groups are difficult to communicate. EPA may have a rich data base on a chemical like perchlorate, but it is unclear whether all the effects are actionable and how to communicate the science and its importance.
- Need for NAS and SAB reports that translate science advice into actions for EPA regions.

EPA Region 3 Scientific and Technical Staff (10:30 a.m. - 12:00 a.m. Session) Participants

Mr. Stuart Kerzner, Acting Regional Science Liaison
Mr. Joel Hennessy, Land & Chemical Division
Ms. Kathy Davies, Hazardous Site Cleanup Division
Mr. Bill Hagel, Hazardous Site Cleanup Division
Ms. Erin Sullivan, Office of Policy & Management
Dr. David Kargbo, Environmental Assessment & Innovation Division
Ms. Ellen Schmitt, Water Protection Division
Dr. Cynthia Stahl, Environmental Assessment & Innovation Division
Dr. Amy Bergdale, Environmental Assessment & Innovation Division
Dr. Al Cimerelli, Environmental Assessment & Innovation Division
Dr. Janet Kremer, Environmental Assessment & Innovation Division
Dr. William Jenkins, Environmental Assessment & Innovation Division
Mr. John Butler, Land and Chemical Division

The first participant spoke of EPA's slow progress towards integration. Risk assessment provided a first step, but EPA's statutory framework and organization reinforce stove piping. Integration requires a change in statute or a "management imperative backed up with resources." Integration requires more than a guidance document or pilot project. Another participant commented on difficulties communicating across divisions, even within Region 3. Region 3 recently completed a "2010 analysis" attempted to address environmental health of region and to look beyond individual program areas. It highlighted the need to characterize uncertainties in science and enhance communication, especially between the air and water programs.

Participants spoke about barriers to integrating information for decision making, including:

- Academic training encourages reductionism and limited acknowledgement of other disciplines' perspectives.
- For traditional issues, it is hard to acknowledge new information, new interpretation of data.
- Interdisciplinary work difficult (e.g., experts often speak different languages and have different assumptions).
- Managers sometimes act as if science can "make the decisions" and that values don't enter in, but values must be integrated as well. Stakeholders don't believe the message that science compels environmental decisions.
- Limited availability of ORD science for regional needs (one participant noting…"Don't find much of the D in ORD." Others, in contrast, commending the Athens lab for support of regional needs); ORD reward structure rewards publications, rather than support for regional needs.
- Participants observed that STAR grant participants were not generally useful to the regions, because STAR grantees often have projects of limited interest to the region.
- Scientists do not always participate in the scoping/problem formulation stage that precedes risk assessment, although Superfund and RCRA corrective action projects do generally involve scientists in scoping projects in their initial stages.

Forces encouraging integration include:

- Different forums across EPA encouraging information exchange (e.g., Groundwater Forum, Federal Facilities Forum, Risk Assessment Forum).
- Regional science details with ORD centers and laboratories.
- Scientists' individual networks and the ORD Regional Science Liaison.
- Some participants reported great luck using ORD's "Science Connector" to identify ORD scientists working on a topic, but other participants noted that the system, like many others, was not fully populated with useful information.
- The MIRA paradigm provides a process for scientists to contribute to problem formulation and scoping. Once a decision context is identified, it allows scientists to identify disparate pieces of data that will be significant indicators and index their significance. The process forces different scientists to assign a value to their indicator on a decision scale.
- Use of models, such as the CADDIS model, that shows ecological problem formulation for large problems like Marcellus Shale, so managers, scientists, and stakeholders can visualize stressors and impacts and identify data gaps.

Scientists emphasized that even when new tools for scoping and developing conceptual models are successful at integrating data for analysis, full integration depends on breaking down stove-piped environmental management (the CADDIS tool, for example, may identify concerns about private drinking wells, but EPA does not have programs to address them). Scientists also may "tee up" complex information for decision makers, only to hear that "the science isn't good enough for a decision," a response that constitutes a decision in itself, either made consciously or unconsciously, about the value of information.

Several scientists agreed that integration is more than looking at the sum of program impacts sequentially and it is more than looking at transdisciplinary knowledge. It is the use of these insights for good decision making, explicit consideration of the benchmarks for evaluating whether an upcoming decision is a good one, and ongoing evaluation of decisions by explicit criteria. Such science integration for decision making requires a long time frame.

EPA Region 3 Deputy Regional Administrator (2:30 p.m. - 3:30 p.m. Session)

Mr. William Early, Deputy Regional Administrator

The Deputy Regional Administrator spoke of the intense need in Region 3 for science-based decision making and Region 3's progress over the past four years in using the logic model and MIRA process to identify key priorities. The "2010 report" uses science and data in a structured way to identify Region 3's key priorities. Many of them cut across traditional program areas. The Region's leadership on MIRA and other decision science applications developed as EPA responsibilities grew and its budget declined. Region 3 found these tools were a practical way to define

where to invest and where to disinvest, how to manage program integration, and how to explain these choices in a coherent way. The MIRA approach is valuable, but it is still challenging to get the scientific and modeling information needed to make it work as effectively as it can.

Region 3 managers and staff are increasingly looking at integrated impacts. There is increased attention to cumulative and synergistic effects. These activities track with the Administrator's priorities. Maps and geographic information systems help the region look at clusters of effects over time and space. Region 3 forms interdisciplinary buckets with staff across divisions to break down stove pipes and address priority issues (e.g., energy bucket, clean communities, mountaintop mining). This approach allows the region to identify "whatever regulatory hooks we have" for priority challenges, such as mountaintop mining. A division director typically supervises a "bucket." Project coordinators develop work plans that identify responsibilities for members across the organization.

The most significant barriers to science integration occur when EPA lacks direct information to address a problem and must rely on anecdotal information. Where that occurs for high priority issues, Region 3 turns to ORD and other partners for science and data to inform decisions. There are opportunities for greater alignment between regional needs and ORD's focus. It would be helpful if ORD developed workable approaches for cumulative impact analysis and took note of regional cross-media, cross-program concerns. It would be helpful to establish an ongoing dialogue to discuss "individual and collective group responsibility" for meeting the science and research needs of the regions. There are needs especially for more IRIS numbers that reflect recent science and have meaning,

The science rationale for EPA's decisions affects Region 3's relationships with its states. States look to EPA for science and consistency, because they lack resources and view science as an EPA responsibility.

Region 3 is considering succession planning for "brain drain and retirement issues" that cluster in some divisions as significant proportions of staff grow older. The region will need to plan for scientists to step into essential technical functions. There is a need for economists, social scientists and behavioral scientists in the region to address community health and cumulative risk questions. There is a "much more involved and skeptical public who are concerned" and asking "what this all means for me." EPA needs to have discussions with all sectors of the public and needs to communicate its science and what it means in terms of cumulative risk. There is a significant need to present science and information more effectively in public meetings and press releases.

EPA Region 4 SAB Science Integration for Decision Making Fact-Finding Interviews
October 26, 2009
Sam Nunn Atlanta Federal Center, 61 Forsyth Street, SW, Atlanta, GA 30303-8960

Four members of the SAB Committee on Science Integration for Decision Making conducted three interviews in EPA Region 4: Drs. Jill Lipoti and Gregory Biddinger conducted the interviews in person and Drs. Deborah Cory-Slechta and Terry Daniel participated by phone. For each interview, Dr. Anthony Maciorowski, Deputy Director of the SAB Staff Office, provided a brief introduction to the purpose of the interview and the Designated Federal Officer, Dr. Angela Nugent, took notes to develop a summary of the conversation. All interviewees were provided a copy of the committee's *Preliminary Study Plan* in advance.

Dr. Maciorowski noted in each interview that the purpose of the interview was to help SAB Committee members learn about Region 4's current and recent experience with science integration supporting EPA decision making so that the SAB can develop advice to support and/or strengthen Agency science integration efforts. Dr. Maciorowski thanked participants for taking time for the interviews and thanked Mr. Thomas Baugh for serving as liaison with the SAB Staff Office in planning the interviews.

Interview with: Mr. Michael Peyton, Director, Science and Ecosystem Support Division and Mr. Alan Farmer, Director, Resource Conservation and Recovery Act (RCRA) Division
October 26, 2009, 11:00 a.m. - 12:00 p.m.

Mr. Baugh began the session by noting that the Acting Deputy Regional Administrator, Ms. Beverly Banister, was unable to participate in the interview because of a personal emergency. In her stead, he introduced Mr. Michael Peyton and Mr. Alan Farmer and asked them to provide a senior management overview of major regional science needs.

The first major topic was the important role of science and ecosystem support laboratories. Region 4's Science and Ecosystem Support Division laboratory has memoranda of understanding with each regional division to support program and enforcement needs. The Division also maintains flexibility to respond to environmental disasters. The Region 4 Science and Ecosystem Support Division has approximately100 federal employees and three contractors in its regional lab in Athens, Georgia, which has a separate and different mission from the ORD lab in that same city. Mr. Peyton noted that EPA has generally phased out or abandoned regional laboratories and that Region 4's retention of a laboratory staffed by federal employees was unusual and reflected the strength of Region 4's science. As a result, "EPA speaks with authority" and can maintain public trust because it can generate the science needed to support decisions (example: data gathered and analyzed in the Kingston Coal Ash case). Region 4's laboratory is ISO 17 accredited. Regional scientists were sufficiently confident to seek SAB advice on the region's Coastal Mississippi Water Quality Assurance Plan in the aftermath of Hurricane Rita.

The next topic concerned relationships between Region 4 science needs and ORD. Managers noted that ORD's current reinvention efforts provide an opportunity to strengthen

partnerships with the regions. ORD's Regional Applied Research Effort (RARE) program provides $200,000 per region per year for priority shorter-term research and technical support needs, a valuable innovation because ORD funds are not generally directed to technical support. For Region 4, RARE helps fund immediate needs for monitoring or to support enforcement decisions.

The senior managers reflected on the big science issues facing the region as a whole They identified the following priority needs:

- Setting Total Maximum Daily Loads (TMDLs) where states don't have data or field capability to figure out contaminants in or characteristics of water bodies. Need to obtain data to populate models to determine if a stream reach is within guidelines and meets permits.
- Need for statistical expertise to characterize uncertainties and determine with more confidence when a sufficient number of samples have been taken.
- Corrective action workload is a major priority. Region 4 has nearly 500 decisions to make by 2020 and is second to Region 2 in having the largest number of Superfund facilities to address.
- Need to maintain capability to address unforeseen events and respond to risks that may be presented by perfluorooctanoic acid (PFOA), perfluorooctane sulfonate, and coal ash. A toxic substance "on the radar for years" may suddenly present itself as a concern.
- Ecological impacts of mountaintop mining to delineate impacts on water resources.

Committee members asked if the following science needs were regional priorities, but the managers responded that they did not view them as priorities:

- Systematic, social-science based systematic assessment of efforts to engage stakeholder and public input into process for reclamation or sampling schemes. Region 4 managers have regular, coordinated discussion of community involvement efforts and rely on community involvement coordinators.
- Values assessment related to mountaintop mining assessments.
- Economic assessments for regional decisions. Region 4 contracts out economic assessments for remedy selection decisions and turns to Headquarters offices when they need assistance.

Managers discussed the "life-cycle" of collaboration efforts between lead divisions and science support divisions. Every regional science assessment begins with scientists and decision makers discussing and documenting problem definition and data quality objectives. Scientists resist pressure from media divisions to "run out immediately and gather data;" scientists need to know the objectives of the assessment before any inquiry begins. Sometimes "media division want to go to contractor because they want to do it faster," but such efforts nearly always result in problems.

Managers also noted that the region has only an informal process for evaluating performance of science to support decisions (i.e., the possible need to do different science, use science better, use public science). Such evaluation happens for major, high-profile issues, but not generally for routine issues. One exception is the Superfund program requirement for five-year analyses of Records of Decisions. The RCRA program is trying to adopt a similar

approach. Superfund analyses, however, focus on whether the chosen remedy worked, but not on whether another remedy could have worked better. Managers acknowledged that a formal evaluation process could be as valuable for improving future science efforts.

The discussion then turned to contractor resources, training, and personnel needs. The trend is to close labs and use contract labs because the EPA doesn't have the sample throughput to justify labs. But for new method development, you need agency labs. The managers noted that EPA has delegated authority to make corrective action decisions for hazardous and solid waste to every state except Mississippi and a few other facilities that states have deferred to EPA. Region 4 has limited resources for contractors to support these decisions. The managers noted that resources were limited for training. For the Science and Ecosystem Support Division with 100 personnel, the training budget is $20,000. Managers find ways to reprogram other funds to increase training support to $50,000. Managers also plan in-house training so that EPA experts can share their expertise. In regard to personnel needs, managers expressed a strong need to hire new scientific staff to maintain the crucial work force to support the basic work of the Agency, especially given projected turnover among older, experienced staff. Managers noted that personnel retention was good; EPA Region 4 scientists are motivated.

Managers also noted the need for EPA to train personnel in lab methods and techniques. The states leverage EPA's ability to protect human health and the environment.

The managers concluded with a brief discussion of how the region might better utilize the SAB as a resource to address environmental science issues.

Interview with EPA Region 4 Managers
October 26, 2009, 1:00 p.m. - 2:30 p.m.

EPA Region 4 Participants:
Mr. Glenn Adams, Chief of Technical Services Section, Superfund Support Branch, Superfund Division
Mr. John Deatrick, Chief, Ecological Evaluation Section; Ecological Assessment Branch; Science and Ecosystem Support Division
Ms. Denisse Diaz, Acting Chief, Enforcement and Compliance Planning and Management Branch; Office of Environmental Accountability
Mr. Doug Neeley, Chief, Air Toxics and Monitoring Branch; Air, Pesticides, and Toxics Management Division
Mr. David Parker, Chief, Wetlands Planning and Coastal Protection Section; Wetlands, Coastal, and Oceans Branch; Water Protection Division
Ms. Dee Stewart, Deputy Director, Region 4 Resource Conservation and Recovery Act Division
Mr. James Webster, Chief, Removal and Oil Programs Section

The SAB committee members asked the regional managers to describe the kinds of decisions their organization makes and their roles in the decision making process.

One manager described his role in supporting emergency response, remedial programs, and Brownfields. His organization reviews data collected by the remedial program and conducts risk assessments. The on-site coordinator uses that information for risk management decisions to determine if a site "meets the cut" and the action needs to be taken or referred. External community involvement occurs through state input to Applicable or Relevant and Appropriate Requirements (ARARS). There are requirements for community involvement for activities lasting longer than 120 days. Some activities, like the TVA Kingston Coal Ash case, have a community advisory board; other community involvement efforts are smaller in scope and duration.

In response to a question about community sampling, one manager described the limits of engaging communities in air toxic sampling. One sampling effort in Louisville, Kentucky, involving air toxics resulted in "grab sample" data that didn't meet EPA's scientific criteria. Region 4 then partnered with a university group and the community to develop a quality assurance plan that met standards in 40 CFR and that secured better data.

Managers spoke of the need for defensible data to support decisions, data that have been developed following a pre-approved method or other scientifically defensible method. The Quality Assurance Program Plan (QAPP) was mentioned as a planning tool. The research is made relevant by spelling out objectives in the planning process. The QAPP is required.

Managers commented that social knowledge often is factored into the scientific process to influence data collection. One example was a RCRA case, where community members believed treated wood presented creosote exposures. EPA followed up on the local knowledge to focus data collection. Social data often proves useful for exposure assessments related to

fishing and hunting. Local data are also used in the wetlands and watersheds program and for decisions related to the 303(d) list of impaired lakes and streams.

SAB members asked whether the region evaluates its use of science for decision making to improve its science support efforts. It might have been helpful, for example, to explore whether universities or communities could have been educated in advance about regional protocols for data collection. Some managers spoke about the difficulties anticipating science problems (i.e., the region may not know of universities or communities conducting studies). Managers responded that decisions in the regions are fast paced and often there is no time to reflect when something (i.e., enforcement, corrective, action, sampling, delisting efforts) doesn't work right. The highest profile issues may be publicized and highlighted in an accomplishments report, but often incremental improvements addressing routine issues don't get attention.

The SAB members asked about the possibility of using site-specific problems, as they arise, as opportunities to learn about science issues of general interest to the region. The region might identify important issues in advance and look for opportunities to gather data from site conditions. Managers responded that they must always be reminding staff that their job is not to conduct a scientific study outside a timeframe, but instead conduct an investigation leading to a specific decision.

Managers spoke about how they lacked science to address immediate problems or where they felt challenged because they needed more defensible science. Specific areas discussed include:

- Identification of PFOA health effects. EPA's Office of Research and Development has helped Region 4 by developing analytical methods but not with interpreting the impact of PFOA on human health while IRIS value is being developed.
- Similar tensions exist for all contaminants.
- Region 4 would benefit from more "maintenance of tools" provided by ORD and others. Region 4 uses models and tools but could use more technical assistance about how to use and interpret them.
- Statistical expertise to develop sampling approach and analyzing reports.
- Disinfection byproducts in water [EPA Region 4 turning to the Agency for Toxic Substances and Disease Registry (ATSDR), which is providing a slow response] EPA's MCLs are out of date.
- Emerging contaminants - endocrine disruptors, PFOA, Bsphenol A (no standards or sampling procedures).
- Numeric nutrient standards -- attractive but problematic - some standards are set too high and some too low.
- Lack of guidance for ecological assessments that would be similar to IRIS and would provide site-by-site ecological risk values.

Managers did note that they did conduct ecological risk assessments to consider multi-stressor effects within the context of TMDLs. They try to identify successes and publicize them. Managers expressed frustration, however, that EPA often lacks authority to address stressors that create the greatest ecological impacts.

Managers noted that have not been tracking recent literature on ecosystem services. They noted that they are waiting for policies and precedents to come from the Fish and Wildlife Service. One manager noted that "for some sites, ecosystem services would get in your way" and be just another expensive assessment to conduct.

Managers spoke about the proportion of regional decisions based on modeling vs. data collection and the standards for data use. TMDLs are mostly based on modeling. Any data is preferred to no data and almost no time is available for quality assurance checking of data received from non-EPA sources. EPA has a hectic pace, given the rate that state TMDLs are being developed. The Superfund program uses a fair amount of modeling for sampling-site selection. But if a site is contaminated, "real data" are used for remediation decisions. The water program compares end-of-pipe data from the regulated party against modeling. EPA's air program uses model values for permitting, but "trues that information up" with monitoring for nonattainment decisions.

Managers commented that they did not see the science need for economists at the regional level because they did not view economics as science. EPA Region 4 had one financial analyst who conducted cost analysis. Often cost analyses are provided by responsible parties. Although one manager noted a concern that EPA may spend "millions of dollars cleaning up a property worth $13,000," EPA is bound by the law and does not have the option to consider economic benefits in Superfund Clean ups. EPA **does** provide technical assistance, tools, worksheets, and other information to communities for Brownfields decision and cooperates in visioning sessions for communities considering cleaning up underground storage tanks, but EPA does not undertake the analyses for those communities considering restoration decisions.

The conversation then turned to training and development of staff and resource constraints. Managers acknowledged that the training budget in the region was limited, but noted that motivated staff can usually find ways to take classes, develop their individual development plans, go to conferences, and be mentored by senior scientists. Some managers expressed concern that training policy and resources were implemented differently across divisions in the Region. In regard to resources to maintain Region 4's scientific staff, one manager noted that his division no longer conducts ecorisk assessments for the region's waste division and now contracts those activities out.

Managers identified a need for a repository of environmental information gathered in all environmental programs that would help Regional science-based decisions. A repository that would store Katrina information and have geo-spatial data information common to all programs and a common data quality approach would foster science integration for better decision making. It would be a major challenge to develop such a repository. Headquarters' efforts to develop a single database for Katrina data is an example of a need for a central repository and of the challenge in developing one. Currently, the many data systems within media offices do not "talk to each other" (e.g., Storet and TMDL information).

Interview with Scientific and Technical Staff
October 26, 2009, 2:45 p.m. - 4:15 p.m.

EPA Region 4 Participants:
Dr. Kenneth Mitchell, Office of the Regional Administrator
Dr. Egide Louis, Air, Pesticides, and Toxics Management Division
Mr. Van Shrieves, Air, Pesticides, and Toxicx Management Division
Mr. Doug Johnson, Water Protection Division
Mr. Craig Zeller, Superfund Division (on the telephone)
Mr. Reggie Barrino, Office of Environmental Accountability
Mr. John E. Johnston, RCRA Division
Ms. Kay Wischkaemper, Superfund Division
Mr. Galo Jackson, Superfund Division
Mr. Luis Flores, Superfund Division

The SAB committee members asked participants to describe the kinds of decisions their organization makes and their roles in the decision-making process.

Participants noted that EPA staffs conduct some risk assessments because they are mandated to support air, water, and waste decisions and other risk assessments where such analyses are not mandated, for example, in response to community concerns about cumulative impacts or support for green remediation. Staff viewed good data and good science as the "bed rock" of federal and state decisions.

SAB committee members asked about use of social science to inform human health and ecological risk assessments. One regional scientist acknowledged that social surveys could inform exposures; most often EPA uses default assumptions rather than surveys populations about exposure patterns. A participant then noted that the region understands that vulnerability assessments are important, but does not conduct them because the region does not have the expertise to conduct or interpret such assessments.

Participants agreed that lack of a shared system of data across EPA programs is a major barrier to science integration. In the dredging program, for example, where EPA works closely with the Army Corps of Engineers, data are collected, but not evaluated or maintained. Within regions and across regions there is no central database and no standard format. In response, Regions have "each gone in their different ways." Specific problems mentioned include:

- Lack of a shared data dictionary with firm rules.
- Problems with air toxics data.
- Scientists working on air issues may not know about Superfund site data and possible emissions related to air.
- Toxic release inventory and the National Air Toxics Inventory have no specific data requirements that must be met. EPA is developing an inventory of greenhouse gas emissions and already maintains an air emissions inventory. These inventories are not coordinated and planned in concert "Nobody knows what's out there; there is no consistency in terms of collection and reporting."

- OPP toxicity values diverge from IRIS, even though "the physical laws of nature do not vary by program office."
- Coordinated available data systems like Envirofacts are just a subset of environmental information.

Regional staff agreed that data coordination is frustrating because it is resource intensive, there is a lack of vision for how an integrated system would to be used, a "reluctance to let go of what is seen as mine," and a fear that quality control may not be present in databases outside a user's control.

EPA staff then named data they "routinely wish they had:"

- Stack locations height, temperatures, and velocity
- Better air data that include local meteorology
- Health effects data for environmental justice communities (e.g., asthma statistics, respiratory and cardio-vascular effects). Region 4 often partners with ATSDR and local schools of public health.
- Statistical analyses comparing assessment results against background levels.

Participants discussed how individuals cultivate their own sources of information through professional contacts within EPA and outside the Agency, Agency workgroups, and professional associations. Participants observed that the region had a "very limited" budget for travel and training. The region doesn't conduct much training; Region 4 brings in a limited number of local trainers and trainers from the Centers for Disease Control and Prevention (CDC).

Participants noted that the regional library had been closed for a short time and recently reopened; many participants were uncertain about the kinds of services offered. Although there are exceptions, a participant noted that "Regional staff don't keep up with the literature, because of time availability and don't have great communication with others across EPA." Staff must be entrepreneurial and sometimes take "heroic action" to get the travel, training funds, and access to information needed. Memberships in professional societies are not supported. Some highly motivated staff work at maintaining contact with other researchers, but that is the exception, not the rule.

One member discussed the need for more resources to cover basic information needs for the region. He reflected that "one person should be the "go-to" person for air databases. Someone should really know about NEI and TRI." Often regional staff go to him for information, but he "wished he knew more….I'm pulled in all directions" since he provides statistical help, biochemical analysis and risk assessments. The Region should more fully staff key science areas supporting Agency decisions and needs more statistical expertise.

Participants then discussed how they prepare packages of information for decisions by managers. Participants noted that staff in the lead program "pull in others" within and outside the region to assemble an analysis. They develop a Powerpoint presentation summarizing the available data and "what does it mean." The assessment "flows up through management." The

lead manager makes a presentation to the Regional Administrator with regional scientists in the room. Participants noted that the Superfund and RCRA programs have specified procedures, milestones, and documentation requirements.

SAB members asked what changes could be put into place that would assist in making good scientific decisions. One meeting participant pointed out that TSCA PCB regulations require an ARAR for a site without respect to risk assessment required under CERCLA. Updating regulations would enable the use of site-characterization data and a CERCLA risk assessment to support remedial alternative selection for sites.

The scientific staff noted that EPA programs differ in how they factor in inputs from the regulated community, environmental groups, and the general public. They noted that involving stakeholders takes a lot of time. When involving environmental justice communities, a lot of time was spent addressing issues that were not very risky, while other issues which carried more risk were not addressed. There was a feeling that the general public should have more trust in scientists and not distract scientists with emotional issues which had little impact to public health. A science assessment undertaken for a non-regulatory effort in a community is likely to have many opportunities for technical training and input. Air decisions would involve a public hearing. Superfund activities follow a structured process for engaging the public.

SAB members asked whether regional staff were aware of SAB and National Research Council reports and advice on integrated decision making and science-based stakeholder involvement. One participant acknowledged that he had "copies of the reports on his shelf" but needed training to increase his awareness of the recommendations and their relevance to his work. He suggested that SAB members seek opportunities to train EPA staff because "people are open to getting training outside their areas." . Others expressed doubt that the SAB's advice would assist them in their day-to-day work. "The SAB is comprised of academics who never stood up in front of a public meeting. The concepts in the reports just don't address what I do."

The SAB committee members asked about efforts to evaluate the Region's use of science after decisions have been made. Participants made the following observations:

- In working with the state of Tennessee on an air monitoring effort using EPA data protocols, one scientist observed that the monitoring went well but the impact of that improved monitoring on public trust is not known. The region has not received direct feedback on how good the science was for making decisions.
- By contrast, the Region has spent more time evaluating the Kinston coal ash event, where the "immensity of the event is amazing." In that case, the region developed a close analysis of the clean up.
- The Superfund program conducts five-year reviews.
- One member observed that he "often doesn't know the final decision made based on assessment he provided." Sometimes there's a disconnect …"sometimes I'm too far down to know final decision made."

- Although EPA has recently devoted greater effort in defining measures of success, many measures "are very soft."
- The region does not use social scientists to develop measures of success for voluntary efforts.

EPA Region 5 Science Integration for Decision Making Fact-Finding Interviews
January 22, 2010
77 West Jackson Blvd.
Chicago, IL

Four members of the SAB Committee on Science Integration for Decision Making conducted three interviews in EPA Region 5: Drs. James Johns, Catherine Kling, and Thomas Theis in person and Dr. Wayne Landis by telephone. For each interview, Dr. Anthony Maciorowski, Deputy Director of the SAB Staff Office, provided a brief introduction to the purpose of the interview and the Designated Federal Officer, Dr. Angela Nugent, took notes to develop a summary of the conversation. All interviewees were provided a copy of the committee's Preliminary Study Plan in advance.

Dr. Maciorowski noted in each interview that the purpose of the interview was to help SAB Committee members learn about Region 5's current and recent experience with science integration supporting EPA decision making so that the SAB can develop advice to support and/or strengthen Agency science integration efforts. Dr. Maciorowski thanked participants for taking time for the interviews and thanked Dr. Carole Braverman for serving as liaison with the SAB Staff Office in planning the interviews

Meeting with Acting Regional Administrator and Acting Deputy Regional Administrator (9:45 a.m. - 10:30 p.m.) Participants

Mr. Bharat Mathur, Acting Regional Administrator
Dr. Walter Kovalick, Acting Deputy Regional Administrator

The Acting Regional Administrator observed that EPA regions share several common features in their approach to science. They depend on headquarters offices for science, technical assistance, and guidance; they do communicate across regions; and they all have regional-specific science councils.

Region 5 uses science across all its media programs and many different activities (e.g., permits, inspections, and clean-ups). In some cases, "science is prescriptive," as in the air program, where there are EPA- approved methods. In other programs, Superfund and RCRA, for example, there is more flexibility in the interpretation of EPA methodologies and choice of modeling methods.

Typically, the Regional Administrator and Deputy Regional Administrator become involved in problem formulation when an issue involves complex, novel, or controversial science. The region delegates other types of problem formulation down the management chain. The region fosters an environment where Region 5 staff is able to pursue "true science" without some of the political pressures program offices may experience at headquarters. This situation may foster a bit of inflexibility, where a Region 5 scientist may not view "outside science" (e.g., sometimes new science from other regions, or from regulated entities) as initially credible. There is a tension between the need for consistency within EPA and concern that consistency may sacrifice keeping pace with evolving state of the science outside EPA. Region 5 scientists

typically keep abreast of scientific and technical literature in their fields and integrate information from published literature into regional strategies, such as the region's refinery initiative. One area for expansion may be in the area of economics. There may also be a need for Region 5 to consider economics more than it currently does in the formulation of different kinds of decisions.

Although the region does not conduct hypothesis-based research, it applies and generates scientific information. Regional scientists develop new analytical methods for EPA and compete and win ORD RARE and monitoring grants.

To create an atmosphere where science is a major input for decision making, the region tries to hire "smart people" with an ability to network with scientists across the agency; "interfere as little as possible" in their work; and consistently send the message that Region 5 relies on the "best science and the best law" to protect the environment. With 1,200 employees, Region 5 is the largest region. It has a 3% annual turnover; departures generally occur among the "Millennials" (employees in late 20's) and employees in the 40-50-year-old range. The regional Science and Technology Council develops programs and seminar series to benefit Region 5 and "refresh scientists." Region 5 has developed an orientation program for "Millennial" employees designed to inform them about different programs (and possible career opportunities) in the regional office. There is a need to recruit new scientific and technical staff with a holistic approach to environmental protection. Environmental science departments increasingly train students with a broad perspective, so that new graduates have backgrounds not only in their specific disciplines, but also in information technology and teamwork.

Region 5 also has a need for scientists who have an ability to listen to and assimilate public input and interact with communities. There is a need for new mechanisms to encourage exchange of ideas with the public beyond traditional public meetings with the usual follow-up "responsiveness summary." There is a need to teach these skills and for leaders to encourage them.

The region finds it difficult often to find a match between ORD's research and regional science needs. Region 5 is now exploring a possibly larger role in ORD's choice of topics for solicitation of grants and is in the process of reviewing STAR grants awarded in the Region over the past ten years to connect Regional scientists with relevant research and to identify possible speakers for a new seminar series. Overall, there is a need for a system where regional needs get adequate priority or possibly a new role for ORD, where they can be a broker, pointing to other agencies that can provide regions with needed science. Where Region 5 has strong relationships with ORD, as with its Duluth laboratories, the relationship usually springs from personal contacts among scientists and is not institutionalized as an important agency function.

The Acting Deputy Regional Administrator also provided the committee members with a publication summarizing Region 5 efforts to promote innovative technologies and a summary of FY 2009 Region 5 Science & Technology Council Accomplishments.

Meeting with Region 5 Senior Managers (10:30 a.m. - 12:00 p.m.) Participants.

Mr. Doug Ballotti, Deputy Director Superfund Division
Mr. Jose Cisneros, Remediation and Reuse Branch Chief, Land and Chemicals Division
Mr. Dave Cowgill, Program Manager, Great Lakes National Program Office
Ms. Jerri-Anne Garl, Materials Management Branch Chief, LCD
Ms. Linda Holst, Water Quality Branch Chief, Water Division
Mr. Dean Maraldo, Wetlands and Watersheds Deputy Branch Chief, Water Division
Mr. Bruce Sypniewski, Deputy Director Air and Radiation Division
Ms. MaryPat Tyson, Air Toxics and Assessment Branch Chief, Air and Radiation Division
Mr. Alan Walts, Director Office of Enforcement and Compliance
Mr. Dennis Wesolowski, Director Chicago Regional Lab

Managers provided perspectives on science integration from different program areas. The air program responded to a state request to define an exceedance, which could have had an impact on a PM non-attainment decision, as an "exceptional event." Region 5 conducted unusual analyses, engaged cross-disciplinary experts (e.g., meteorology, chemistry, monitoring), and requested additional sampling to make a determination of whether the exceedances related to a fireworks display. Analysis of the data point was critical to a significant decision and merited a high level of scrutiny. Region 5's efforts led to national committee to develop science methods (e.g., protocols, quality assurance, audits, procedures for monitoring for bias) to support determinations for exceptional events,

Remediation programs take a team approach to science integration. For Superfund and RCRA clean-ups, teams of biologists, chemists, engineers, geologists, and toxicologists typically meet to scope the problem and problem solving is tailored to issues at particular sites. Region 5 scientists reach out to state counterparts and scientists in the Fish and Wildlife Service and the U.S. Geological Survey. One area for improvement may be to develop skills for communicating with and listening to communities affected by clean-up sites.

The Superfund Program is not a delegated program. The Region 5 Division Director signs Records of Decisions resulting from evaluation and assessment of risks at sites. The Superfund Program relies on Headquarters guidance for human health and ecological risk assessment and decisions based on that analytical process have huge impacts. Costs can be in the billions. The nation's largest river remediation site is the Fox River in Wisconsin, which will likely take 15 years to remediate. In making decisions, managers consider the cancer slope factor and RfD for the relevant chemicals. In the case of the Fox River, exposure concern related to human fish consumption and contamination through sediments. Region 5 did generate an ecological risk assessment, but human health concerns drove the clean-up decision. The Superfund program mandates community involvement at multiple steps.

EPA does not conduct a formal benefit-cost analysis for Superfund sites. Instead it considers the benefits of different remedial options, against the cost and time for recovery. Region 5 managers find it difficult to communicate the cost-effectiveness of different options to the public.

Region 5's enforcement office looks for science to support cross-cutting issues, such as environmental justice, cumulative risk, and community-based risk assessment. Science offers a tool for targeting work of enforcement programs on higher levels of risk. Science needs for this work include:

- Need for simpler analytical tools for problem formulation.
- Need to link cumulative risk analysis to more holistic problem solving than just to a list of actions that individual programs can take.
- Need for process for developing methods to address emerging issues.
- Investment in validation of analytical methods by multiple laboratories.

Region 5 has a Materials Management Branch, which relies on scientific information for a voluntary program aimed at preventing hazardous materials from entering the environment and encouraging reuse, recyclying, and safe waste disposal. Science needs include:

- Information on emerging chemicals.
- Research on lifecycle analysis.
- Information on beneficial use of coal ash and a variety of building materials .
- Social science for communicating technical information and risk communication.

Region 5 includes the Great Lakes National Program Office (GLNPO), whose main mission is to track and report the health of the Great Lakes and to work with Canadian government, states, tribes, and other federal agencies on Great Lakes issues. The region supports two research vessels, the Lake Guardian, which monitors well-mixed water trends and the Mud Puppy, which monitors sediments. The program also has a clean-up component and administrators a new fund ($475 million) for Great Lakes Restoration, of which $250 will be transferred to other federal agencies and other funds will be awarded through grants. The overall focus is on actions to improve the Great Lakes.

Science issues range widely. Air deposition forces consideration of environmental issues on a continental scale. Each Great Lake has separate issues. Invasive species are an important concern, raising new scientific questions for which policy has not been established (e.g., the validity and use of tests for environmental DNA in water related to possible presence of Asian Carp). There are multiple mechanisms for public involvement. The Great Lakes Restoration Initiative arose from environmental concerns throughout the basin. Each lake has a community involvement group, as do 30 coastal cities, known as “Areas of Concern.” The State of the Lakes conferences work on developing indicators, and sharing research results with government managers. GLNPO now is looking to states, cities, port authorities, and industries as sources of cost sharing for sediment clean-up efforts, however states have great difficulty generating the non-Federal match. GLNPO finds it challenging to communicate the benefits of sediment clean-up to help persuade potential partners and has identified the need for economic science related to ecological valuation.

For the Water Quality Standards program, the principal science integration issue is lack of data. One success story, where Region 5 worked across disciplines and organizations to fill a key data gap, involves sulfates. EPA's existing water quality criteria for sulfate was set at a level designed only to protect livestock from drinking water contaminated by sulfates. EPA has no

national criteria recommendation for sulfates to protect aquatic life. Environmental groups asked Region 5 to review and object to State of Illinois NPDES permits for mine wastes contaminated by sulfates because Illinois EPA was issuing mining permits based on a less stringent alternative effluent standard for sulfate, rather than limits based on the sulfate water quality standard. Upon review, EPA agreed and the Agency objected to the issuance of numerous subsequently proposed permits. As a result, Illinois EPA backlogged the issuance of more than 80 existing mining permits and permits for six new mining facilities because the applicants could not comply with water quality-based effluent limits to meet Illinois' water quality standard for sulfate. The issue became controversial as coal companies contacted the Administrator and Regional Administrator about permit delays.

To address the problem, Region 5 collaborated over ten months with a diverse group (including Office of Water scientists, a representative from ORD's Duluth laboratory who authored EPA's aquatic guidelines, a representative of the coal company and their contractor, and environmental groups) to develop a new assessment of the science, including a review of the literature and new toxicity data. The resulting assessment determined that sulfate toxicity is affected by chloride and water hardness and resulted in complex criteria equations that the state adopted, were approved by EPA and that the "coal companies and environmental groups could live with." Several other states are working to adopt the approach. The effort was successful because EPA kept the focus on defensible criteria that were protective of aquatic life and was open to new information.

Regulatory time constraints impose a significant barrier for science integration in the Total Maximum Daily Loads (TMDL) program. States assess waters every two years to determine impaired waters [i.e., waters that do not meet state standards and designated uses and that are listed on the states 303(d) list]. If waters are impaired, states must develop a TMDL for point sources of pollution. Region 5 has 30 days to review and approve proposed states' proposed lists. This is a challenging timeframe because waters can be complex. Region 5 has asked states for draft copies of the list so there will be additional time for the review.

Review of TMDLs can involve significant integration of science and data from multiple sources. Last year, for example, Region 5 disapproved a portion of the proposed list provided by Illinois, which wanted to remove nitrogen impairments, on the rationale that nitrogen was not an environmental problem Region 5 worked with Office of Water experts and academic contacts to develop a rationale for disapproving that action.

The TMDL program uses its grant-making authority to build science capacity at the state level. It has awarded grants to help the State of Wisconsin work with local communities and the University of Wisconsin to develop the science base for TMDL decisions, especially for non-point source. Region 5 also recognizes the need for social science to build understanding of best management practices that can reduce non-point source pollution.

Meeting with Region 5 Scientific Staff (1:30 p.m. - 3:00 p.m) Participants

Dr. Carole Braverman, ORD Regional Science Liaison
Dr. James Chapman, Ecologist, Superfund Division
Mr. Chris Choi, Superfund Division

Mr. Michael Compher, Environmental Scientist, Air and Radiation Division.
Ms. Kimberly Harris, Team leader for the multimedia perfluorinated chemicals (PFC), Water Division.
Dr. Mario Mangino, Toxicologist and risk assessment specialist, Land & Chemicals Division
Mr. Bob Newport, Environmental Protection Specialist, Water Division
Ms. Michele Knox Palmer, Region 5's Science and Technology Coordinator
Mr. Randy Robinson, Regional Meteorologist, Air and Radiation Division
Mr. Paul Ruesch, Environmental Engineer, Land & Chemicals Division
Dr. Maryann Suero, Children's Health Program Manager, Land and Chemicals Division
Ms. Louann Ungar, Environmental Engineer, Water Division
Dr. Luanne Vanderpool, Geologist, Superfund Division
Dr. Mary White, Ecologist, Land and Chemicals Division

The first participant described how staff scientists both apply science in ways approved by national program offices (e.g., through use of approved models, and develop science where national guidance does not fit.

Interviewees identified impediments to science integration across all the categories of interest to the SAB committeee. Impediments include:

- Difficulty in communicating uncertainties.
- Short time frames for science to support decisions.
- Limited resources.
- Limited data to support decisions (because of limited time and resources).
- Limited public interest in ecological risk, as compared with human health risks.
- Limited interaction in some programs between risk assessment staff and decision makers. Some staff report decision making as a "black box experience;" scientific input goes to a project manager and division directors make decisions, but technical staff don't know how the decision was made.
- Outdated IRIS assessments.
- Annual commitment measures that create barriers to adoption/testing of new approaches, such as ecosystem services .
- Need for science approaches for cross-program initiatives like children's health (e.g., EPA is not using tools consistently, building a common strategy for using public health data) .
- Difficulties learning about ORD research efforts underway, ORD experts regions can tap, and ORD products relevant to regional needs.
- Lack of Regional expertise in energy and environmental impacts.
- Reduced size of Region's traditional library; lack of awareness about how to use on-line library tools; difficulty of finding scientific information in EPA's on-line dockets.
- Limited hiring of new staff; especially expertise at a senior level.
- Lack of succession planning to replace experienced staff who retire .
- Lack of travel money and time for professional conferences.
- Lack of advancement and promotion potential for scientific staff .

Factors that help science integration across all the categories of interest to the SAB committee include:

- Information exchange with states, ORD.
- Information exchange with OAQPS on air modeling issues
- Information exchange through the Groundwater Forum with experts in other regions, states, ORD's Ada Oklahoma laboratory, and OSWER
- Adequate time for staff to keep current on relevant research.
- Successful roll-outs of ORD products and tools.
- Consultations with Headquarters and ORD when issues raised by an emerging contaminant fit no single environmental programs or guidance. Discussions of how solving a regional issue could strengthen a larger program can result in a study that can generate data to help a regional need and help solve a potential national problem.
- Partnerships with associations and non-governmental organizations (e.g., US Green Building Association and Center for Neighborhood Technologies) to strengthen the science base and impact of voluntary programs.

EPA Region 6 Science Integration for Decision Making Fact-Finding Interviews
December 9, 2009
1445 Ross Avenue, Dallas, Texas, 75202

Three members of the SAB Committee on Science Integration for Decision Making conducted three interviews in EPA Region 6: Dr. Terry Daniel in person, with Drs. Deborah Cory-Slechta and Catherine Kling participating by phone. For each interview, Dr. Vanessa Vu, Director of the SAB Staff Office, provided a brief introduction to the purpose of the interview and the Designated Federal Officer, Dr. Angela Nugent, took notes to develop a summary of the conversation. All interviewees were provided a copy of the committee's Preliminary Study Plan in advance.

Dr. Vu noted in each interview that the purpose of the interview was to help SAB Committee members learn about Region 6's current and recent experience with science integration supporting EPA decision making so that the SAB can develop advice to support and/or strengthen Agency science integration efforts. Dr. Vu thanked participants for taking time for the interviews and thanked Dr. Michael Morton for serving as liaison with the SAB Staff Office in planning the interviews.

Participants in Discussion with Senior Managers

Ms. Lynda Carroll, Director, Management Division
Mr. Carl Edlund, Director, Multimedia Planning and Permitting Division
Mr. Sam Coleman, Director, Superfund Division
Mr. Myron Knudson, Senior Policy Advisor to the Regional Administrator
Mr. Rick McMillin, Chief, Laboratory Analysis Section, Houston Laboratory
Mr. William Luthans, Deputy Director, Multimedia Division
Mr. Steven Gilrein, Enforcement Division
Mr. Miguel Flores, Director, Water Quality Protection Division
Ms. Deborah Ponder, Deputy Director, Environmental Justice/Tribal Division
Mr. Randy Gee, Associate Director, Tribal Affairs
Mr. Benjamin Harrison, Deputy Regional Counsel

The discussion began with a request for the SAB to define "science." Dr, Vanessa Vu responded that for this study, the SAB defined science as the use of scientific knowledge and data to answer environmental protection questions. Science can include chemistry, biology, toxicology, engineering, social, or economic sciences.

Participants were asked to comment on any of the major areas of enquiry in the SAB committee's study plan. A participant began the conversation by noting the massive deterioration of ORD over the past 10 years as a result of a budget cut of $100 million, along with inclusion of line items not part of ORD's overall program. The only area for growth has involved homeland security. ORD's reduced budget has affected the regions. ORD has eliminated the Environmental Monitoring & Assessment Program and programs that benefitted the regions in both the short and long term. He asked SAB to communicate that ORD's budget problems delay assessments needed for regulations and EPA's ability to address future problems presented by nanotechnology, endocrine disruptors, and pharmaceuticals.

Another participant noted that regions no longer benefited from funding for regional geographic initiatives, which supported innovative environmental research important to the regions. Each region has its own set of priorities. Because of its geography and history, Region 6 has a special interest in research related to hazardous waste combustors, indoor environments affected by vapor intrusion, spectral imaging for air emissions, passive monitoring techniques as EPA expands nonattainment areas, new federal reference methods, and methodologies for measuring asbestos contamination. Because tremendous energy networks exist in the Region, there is a need for research on systematic conservation of energy that will positively affect air quality, water quality, and climate change.

A manager commented on the needs of tribes who participate in the national tribal science council. Tribes have identified a need for efficient, inexpensive tools such as superconducting radio-frequency technology and ozone testing. Tribes need reliable tools that can give them confidence that they are doing good science.

Another manager observed that additional funding for science is not likely. Although resources are a major issue, another problem related to science integration is the different time frames for the scientific strategic process, which can have an 18-year horizon and the political strategic process, for which long term planning can be as short as 18 months. Science cannot catch up with policy. An example is global warming, which has suffered for lack of earlier investment.

The Superfund program requires immediate solutions. ORD, however, provides research on remediation and technology not related to specific field implementation. One manager described how he tried to fill a research gap by investing Region 6 funds to address a specific problem only to find that ORD has duplicated the research. The regional Superfund program has not found a way to mesh research planning at the regional level with ORD.

Another regional science need relates to public focus on bad or misleading science. One example involved sampling data generated by universities during Hurricane Katrina. University scientists collected samples that were not statistically valid and posted this information on the web as monitoring data. EPA still receives questions about these data and has difficulties communicating the need for approved protocols and good science in providing environmental information. EPA encounters problems communicating the science and engineering involved in environmental protection.

The region has a science policy advisor and an ORD science liaison to help integrate science across the programs. Regional managers have also worked in ORD to learn how ORD deals with regional science and technology needs.

Another manager noted that ORD does a better job of meeting Superfund needs than the needs of other regional programs. In his view, a greater concern was long-term research needed to bridge the gap between policy and science. He called for investment in full lifecycle analysis of science and decision making. Without a full lifecycle analysis, short-term solutions become long-term problems. Oxygenates in fuels reduce air quality. MTBE ends up in groundwater.

Increased production of ethanol may contribute to climate change. He applauded the requirement for lifecycle analysis in the Energy Independence and Security Act.

The SAB committee member asked whether there were mechanisms to "feed back" information about science applications in the field to ORD and other regions. Integration requires exchange of information in multiple directions.

A manager responded that regions could benefit from increased research on communication of science. EPA and the public often look at the same issues and reach different conclusions. EPA needs to learn how to communicate data quality objectives both to scientists and non-scientists.

A manager responsible for enforcement spoke of the need to use science to target enforcement actions. There is a need for technologies for remote sensing for all media (i.e., air, water, soil contamination) and multi-media monitoring that provides genetic speciation linking contaminants to different sources (e.g., humans, cows, avian sources). The region must constantly prioritize its activities and focus on communities co-located with industrial and agricultural complexes. He also called for affordable ways to treat pollutants in small communities. Reverse osmosis for arsenic is one example of a technology that is not affordable by communities.

To one manager, science issues in the region could be traced to four factors: lack of knowledge; lack of time; lack of communication; and lack of integration. Regional managers often don't know what ORD is doing and what universities are doing. Much too often, regional managers only learn about innovations important to the region's mission by accident Lack of communication is a big problem. ORD should talk about the relevance of its research findings at regional offices. Lack of time plays a role. There are so many programmatic issues, that regional staff often don't have the time to understand the science involved. The ORD regional science liaison plays an important role, but there are so many different labs and ORD activities, ORD might usefully place additional scientists in regional offices. Finally, lack of integration across media is a continuing problem. EPA statutes and the Region 6 organization encourage a single-media perspective. EPA could invest more in cumulative risk and the integration of social and economic science with "regular science." As American society becomes increasingly urbanized, different ecosystem problems will emerge because of increase population density. New technologies, such as cell phones and computers also will change how people experience their environment. EPA must provide more affordable treatment technologies for tribes and small communities without delivering different levels of protection for "haves" and "have nots."

A manager responsible for the Houston laboratory provided some remarks related to science integration. His organization doesn't "get involved in policy setting," but analytical results from his lab contribute to decisions. He called for more science designed to meet new challenges presented by chemical warfare and pharmaceuticals. He noted that the laboratory's portfolio has expanded to add new activities and responsibilities (e.g., chemical warfare testing) without adding staff or changing their expertise in major ways. He suggested that ORD organize meetings and workshops, whenever it released a new technique or method.

Another manager followed this comment by telling a story about learning by chance about research at ORD's Ada, OK Laboratory on geological sequestration of carbon. Region 6 is very concerned with growing carbon dioxide emissions. It is also the region with the greatest capacity for geological sequestration. Because of that one chance conversation, Region 6 is working with the Ada, OK laboratory and local universities to build expertise about what happens to carbon dioxide after it is pumped into the ground. The region is building expertise to evaluate regulations for new wells, conduct site characterization, and approve permits for new classes of wells. The manager expressed a wish that communications between ORD and the Region 6 were more systematic and collaborations routinely sought and developed.

Meeting participants agreed about the need for more information sharing about science activities and research not only within EPA but also with the private sector and other federal agencies. ORD should also invest more resources in synthesis of existing science, a project often not valued by ORD scientists. One interviewee also noted a recent review of EPA's science inventory and the need for transforming it into an interactive tool that regions and programs could use. Regional science liaisons could periodically review activities and communicate about ORD research to the regions.

The meeting ended with a short discussion of social and behavioral science. Managers called for reinvestment in research related to risk communication and the value of social and behavioral sciences to communicate the science supporting EPA's decisions.

Meeting with the Regional Administrator (Dr. Alfredo Armendariz) and Deputy Regional Administrator (Mr. Larry Starfield)

The Regional Administrator provided comments on science integration, especially the relationship of science and policy. He noted that he was in his second week at EPA and drew on his past experience in academia and as a technical advisory to the environmental community in his comments for the SAB.

One of his major concerns is how to get the public sufficiently informed to provide meaningful comment and meaningful input into the decision making process. Often, for a permit, EPA might hear comments on asthma or odors with very little relationship to the waste water treatment modification being considered. People have grievances they need to transmit many times before they can provide comments useful to EPA.

In general, EPA generates good data, but it is hard for the public and even outside scientists to view the data in an integrated way. To understand overall air exposures and consider air toxics exposure, criteria pollutants exposure, inspection data showing the last date of inspection, and current plans for facility expansion, one would have to search for data in five different locations. Some data would be held by EPA; others by the states; some would be web accessible; others would be provided in pdf form. Sometimes it takes a long time for members of the public to get the information they seek. A reasonable goal would be to get all available data for a given facility in an afternoon. People would provide better comments and EPA would make better decisions. He advocated that the SAB recommend integration of data within EPA and with the states.

He noted that EPA does take public participation seriously and provides ample opportunities for comment. A disconnect happens because the public sometimes finds it difficult to frame comments in meaningful ways relevant to regulatory activities. He recommended that EPA seek opportunities to interpret comments in ways relevant to rulemaking. He agreed that it might be useful for EPA to provide guidance, templates, or examples showing how public comment could be useful for EPA.

The Deputy Regional Administrator suggested that it would be helpful for the SAB to provide advice on how the Agency can communicate technical information to people more effectively so that the public can provide more meaningful comment. It would be helpful to understand ways to communicate uncertainties, complex information, and concepts like cumulative risk more effectively.

The Regional Administrator noted that environmental groups can be useful in bridging the gap between EPA and the public. The environmental community has experience interpreting technical data and communicating that information to the public.

The Regional Administrator reflected that the public is interested in a more holistic picture of cumulative risk than EPA provides. Where Region 6 addresses cumulative risk, it tends to present media-specific information, for example, air toxic analysis that looks at multiple chemicals. The public, however, is interested in understanding the overall risks they face--not only through the air, but also through exposures to drinking water, land contaminants, food, and smoking. He remembered members of the public asking "it safe for me to live in this town." Questions like that are "almost impossible to answer" but need to be addressed.

Risk-based targeting is an important tool for regions because it can help set priorities, given limited resources. A systematic method for cumulative risk targeting would be very useful The Deputy Regional Administrator referenced a helpful report by the National Environmental Justice Advisory Committee, which provided guidance for community-based stressors evaluation so that communities could identify targets for self regulation.

The Regional Administrator called for research to lower the cost of monitoring complex air pollutants and personal exposures to a wide variety of chemicals near Superfund sites. He noted the need for improved air toxic monitoring. The city of Fort Worth has only one monitor. Regions with disproportional numbers of industrial facilities have a natural need for additional monitors. He also noted a significant need to understand impacts of pollutants at increasingly lower levels.

In response to a question about high priority needs that ORD could fill, the Regional Administrator responded that it would be useful to have an ability to bring a national expert team into a community for a short period of time, following the model of the Superfund Emergency Response Team. An expert team could be detailed to stay in a community for a month to investigate a problem.

He acknowledged past advice provided by the SAB and National Research Council, but challenged those organizations to provide extracts of recommendations to provide to staff working on those issues so recommendations could be more effectively implemented.

Participants in Discussion with Scientific and Technical Staff:

Mr. Erik Snyder, Regional Air Quality Modeler, Multimedia Planning and Permitting Division
Ms. Adele Cardenas, Senior Policy Advisor to the Water Quality Protection Division Director
Ms. Lisa Price, Environmental Scientist, Multimedia Planning and Permitting Division
Mr. Richard Ehrhart, Environmental Scientist, Multimedia Planning and Permitting Division
Mr. Vincent Malott, Remedial Project Manager, Superfund Division
Dr. Jon Rauscher, Toxicologist, Superfund Division
Dr. Jane Watson, Chief, Ecosystems Protection Branch
Mr. Michael Overbay, Regional Ground Water Coordinator, Water Quality Protection Division
Mr. Scott Ellinger, Environmental Scientist, Multimedia Planning and Permitting Division
Mr. Myron Knudson, Senior Policy Advisor to the Regional Administrator
Ms. Tina Hendon, Environmental Scientist, Water Quality Management Division
Ms. Beverly Ethridge, Environmental Scientist, Water Quality Management Division
Mr. Jeffrey Yurk , Toxicologist, Compliance Assistance and Enforcement Division
Dr. Michael Morton, Region 6 Science Liaison to ORD

SAB members asked regional scientists to describe how their work supported Agency decisions and their perspectives on science integration. Scientists responded in turn. A scientist in the Ecosystem Protection Branch told how the region principally drew on its own expertise and those of contractors, rather than ORD or the academic community, because of time constraints. Her branch developed the science needed for Records of Decisions, based on ORD models. She noted that her program does not have a plan for research needs that involves ORD.

A Superfund Risk Assessor described how he relied on ORD's IRIS numbers and rarely developed independent hazard information. To develop exposure assessments, he relied on ORD's Exposure Factors Handbook, which is "invaluable in providing information that can be tailored to individual sites." The program usually relies on defaults, but when a decision is significantly costly or controversial, the program develops site-specific information. One example is fish consumption in Lavaca Bay. He wondered how new research areas such as genomics would be used for risk assessment, since it did not seem to have outcomes useable for site-specific risk assessment. He noted that he does collaborate with enforcement personnel to look at the impacts of multi-media emissions of multiple facilities in a particular airshed or watershed for the purpose of targeting enforcement actions.

A scientist working with the region's enforcement program observed that ORD documents were not designed for easy use by regional scientists, who need criteria related to site-specific implementation. He also called for ORD to focus on climate change science at temporal

and spatial scales useful for the region. He often finds it difficult to identify ORD experts on particular issues. One exception is ORD's new ecological services program, where the National Program Director serves as the "go-to" person for regional questions related to ecological research.

Scientists in the region have developed a cumulative air risk model, which has been peer reviewed and is included in the Council on Regulatory Environmental Model's inventory. It is fairly widely used for sampling and inspections. The regional air program generally generates its own science, because outputs from ORD sometimes do not help the region implement air policy. One example of such an ORD product is the National Air Toxic Assessment, which contains outdated data from 2002 and does not include newer emission data or reference enforcement actions. Another example is the exposure model HAPEM, which is complex and difficult to use and not validated by monitoring information.

A scientist in the regional RCRA program spoke of difficulties participating in the ORD multi-year planning process. He voiced frustration when multiple regions' priorities were simply listed in an appendix of the multi-year plan. ORD seems to respond quickly only when an issue is particularly controversial or gets political attention. Another scientist in the RCRA program agreed that ORD does not provide much support for her efforts and that she seeks science support from local institutions of higher learning.

Several regional scientists noted that ORD projects are long-term, while regional needs shift in response to on-the-ground issues. They called for part of ORD to be available to act as consultants or resource experts to counsel and assist the regions. The Regional Science Liaison to ORD suggested that the SAB committee review the "45-day study" developed by EPA regions in 2004 in response to a request from Dr. Paul Gilman, former Assistant Administrator for ORD and EPA Science Advisor. That 2004 study discussed many of the issues raised by Region 6 staff and provided recommendations.

A RCRA scientist voiced concern that politics sometimes precluded attention to the science related to an issue. One arena is industrial materials recycling, where states have beneficial use determinations and science concerns about protectiveness have sometimes been ignored. Past decisions not to follow through on science concerns and instead defer to states, have resulted in problems like the Kingston Coal Ash spill that have "put the Administrator in the hot seat." Another scientist voiced concern that too much decision making is delegated to states and that states sometimes do not make policies adequately informed by science. He noted that Oklahoma allowed one facility to detonate a million pounds of explosives without a groundwater permit. Region 6 is now reexamining data requirements involved in such permits.

A scientist working in the RCRA program spoke about the resources available to him to investigate soil, ground water, and develop different remedies. "Cost and time are always considerations." He also noted that Region 6 has a strong Brownfield program, which works with states to document benefit use and limitations. Those added determinations require significant time for community input. EPA actively promotes Brownfields programs for Superfund sites because those operate as part of a federal program. RCRA is delegated to the states; Region 6 encourages states to promote Brownfields planning and use.

A second Superfund scientist agreed that the Superfund program benefits from strong support from ORD and the Office of Solid Waste and Emergency Response (OSWER). There is an ORD Superfund liaison in each region who facilitates communications about new sciences and new remediation technology and provides feedback from the regions to national program officers. There are groundwater, engineering and federal facility forums, and ORD participates in monthly Superfund calls and bi-yearly meetings. He recommended webinars provided by OSWER through the Clu-In program. This mechanism centralizes access to training and information.

The Superfund program also manages an effective peer review process, where experts in vapor intrusion or groundwater, for example, develop issue papers and get feedback from regional offices. The process sometimes takes a long time, but ultimately develops the guidance regions need. One current issue involves responsibility for photographic analysis and maintenance of historical photos, an issue important to regions when tracking historical waste disposal activities at Superfund and RCRA sites. The Superfund program benefits from funding appropriated specifically for Superfund needs.

A scientist working in the Region 6 Multimedia Planning and Permitting Division described his fortunate experiences working with ORD, which provided references, consultation, and peer review for his applied research. He distinguished regional science activities from science supporting national policy and rulemaking. There is an intensive effort in national program offices to follow administrative procedure, work in a formal process, and bring in science from stakeholders and trade associations. In the region, each scientist develops "his own framework" based on "science fundamentals." This framework may involve consultation with internal regional experts, contractors, managers, outside scientists, and states. Individuals learn for themselves and learn that external political decisions greatly affect regional scientific analysis.

Another scientist described a major project involving development of an alternative asbestos control method that challenges an existing National Emission Standards for Hazardous Air Pollutants asbestos "Chart Rule," which requires clean-up if materials contain more than one percent asbestos. As a result, many abandoned buildings are not being renovated for potential use because of potential costs and liability concerns over asbestos-containing materials. Region 6 initiated research on alternative clean-up approaches and has worked with ORD's National Risk Management Research Laboratory. EPA invested $3 million in research and the resulting reports are being peer reviewed. The regional scientist noted delays in releasing the research because it challenges EPA's current clean up regulations,

A scientist in the air program described the importance of air quality modeling to air pollution control. Modeling contributes to determination of the ozone state implementation plans, regional haze decisions, and permits. Region 6 benefits from tremendous investment by the State of Texas in air pollution science. A percentage of car registration fees in Texas goes to generally to air research and specifically to model development. Local universities host scientists conducting research with that funding. He works with two air quality models, CMAQ, developed by EPA, and CAM_x, a proprietary model, which has components with

updated science addressing particulate matter. He believes that emissions from coal-fired power plants can be effectively studied with CAM_x and commented that ORD would benefit from interacting with modelers in Texas to expand their air quality modeling knowledge and capabilities.

Scientists at the regional laboratories spoke of the need for more efficient and less labor intensive protocols to support regional customers needing data analysis for site assessment and clean ups. They called for more communication among regional laboratories, between ORD and regional laboratories, and between regional laboratories and headquarters offices. There is a lack of resources and personnel to develop more efficient methods for current pollutants and methods for analyzing new pollutants.

EPA Region 7 Science Integration for Decision Making Fact-Finding Interviews
December 16, 2009
901 N. 5th St. Kansas City, KS

Three members of the SAB Committee on Science Integration for Decision Making conducted three interviews in EPA Region 7: Drs. Catherine Kling and Gary Sayler conducted the interviews in person and Dr. Terry Daniel participated by phone. For each interview, Dr. Anthony Maciorowski, Deputy Director of the SAB Staff Office, provided a brief introduction to the purpose of the interview and the Designated Federal Officer, Dr. Angela Nugent, took notes to develop a summary of the conversation.

Dr. Maciorowski noted in each interview that the purpose of the interview was to help SAB Committee members learn about Region 7's current and recent experience with science integration supporting EPA decision making so that the SAB can develop advice to support and/or strengthen Agency science integration efforts. Dr. Maciorowski thanked participants for taking time for the interviews and thanked Ms. Brenda Groskinsky, Science Policy Advisor and ORD Science Liaison for Region 7, for serving as liaison with the SAB Staff Office in planning the interviews.

EPA Region 7 Manager Participants (8:45 - 10:00 a.m. Session)

Ms. Cecilia Tapia, Director, Superfund Division
Dr. Ron Hammerschmidt, Director, Environmental Services Division
Mr. Gene Gunn, Chief, Special Emphasis and Remedial Branch, Superfund Division
Ms. Luetta Flournoy, Deputy Director, Policy and Man
Mr. Don Toensing, Chief, RCRA

SAB members began the discussion by asking managers to provide their perspectives on the following five areas:

- Practices for integrating science to support decision making
- Consideration of public, stakeholder, external scientific, and other input in science assessment
- Drivers and impediments to implementing past recommendations for science integration
- Ways program receives feedback on how science is used in decision-making
- Workforce to support science integration for decision making staff to identify their principal customers.

One manager began the discussion by noting a need to attract "top scientific talent" in air quality modeling. There is a "limited universe of qualified people" at the state level and in Region 7 to review and approve state implementation plans. This is a critical need because millions of dollars of controls depend on the accuracy of models. When Region 7 loses an expert in this area, it is challenging to get an expert with the right skill set. A state typically prepares a modeling demonstration to show that reducing emissions can achieve the standard set for a criteria pollutant. The state's effort goes out for public comment and there is limited peer review. EPA must review and approve the state's plans.

Another manager described how his unit provides human health and ecological risk assessments for the Superfund and RCRA programs. The process for analyzing contaminants of interests works well and "gets into decisions." Science integration also happens when *ad hoc* groups form inside the region to address issues, like vapor intrusion, that cut across programs. Region 7 benefits from teamwork encouraged by its small size. People know "who to go to and who to team with" and work well together.

For water monitoring and nutrient criteria, there are external technical advisory groups at the regional level. Experts from states, tribes, other federal agencies (e.g., the Fish and Wildlife Service) and academic groups discuss benchmarks for lakes and rivers.

One impediment to science integration is the "tension between research and applied science." The region is often faced with issues that don't fit ORD's timeline. One example is the intensity of the Region's need to get model applications up to speed so they can support regulatory processes. Regulatory time constraints sometimes impede getting the best science.

Two other managers described how enforcement programs are sometimes constrained by limited science. They described an old regulation in the RCRA program that exempted Chromium(VI), also known as hexavalent chromium, present in tanning waste. The old rule involved "slim discussion" of the scientific bases for including and excluding chemicals, but the public was concerned about a possible link between Chromium(VI) and brain tumors. Region 7 tapped outside experts and formed a team of risk assessors, bench scientists, scientists from the enforcement division, and the state of Missouri and requested assistance from the Office of Research and Development to focus on Chromium(VI) hazard issues.

The manager responsible for the Region's Superfund Program described it as a "safety net" for other programs. She noted that Region 7 centralized its risk assessment functions for air, RCRA, and Superfund in 1999. As a result, scientists are independent and provide consistent assessments across the region. The Superfund program itself includes a technical staff of engineers and geologists, oriented to implementation. She cited effective collaboration with ORD's National Risk Management Laboratory in providing point-of-entry and point-of-use water filtration for homes in a community after a Superfund On-Site Coordinator discovered that "people sometimes don't use bottled water" provided by the Region. The coordinator brought this practical concern to the attention of the "Regional Decision Team" of risk assessors, the site manager, and counsel. The ORD National Risk Management Research Laboratory responded to the need to provide the filtration system, a more effective source of water that addressed both inhalation and ingestion routes of exposure.

The manager noted that in the construction/clean-up phase of Superfund projects, her division focuses on civil engineering, construction management, and project management. There is an incentive for "local hires" because of the community focus of the work. The Superfund Program is friendly to local communities. Where a need for special expertise arises, the Regional Science Liaison for ORD helps to find support.

Another manager described how the region worked with water quality standards, based on directives set by the Office of Science and Technology in EPA's Office of Water. The Water

Quality Standards Program sets standards to be protective of uses in different water bodies with no consideration of economics. Sometimes, as for arsenic (set at 18 parts per trillion), the limit is very difficult to implement and can have major economic implications. Unlike site-specific clean-ups, water quality decisions can affect whole states. Plaintiffs and stakeholder involvement provide the major feedback on science integration. State regulatory agencies and municipalities currently struggle to comply with water quality requirements, because of the expense of monitoring at a time of severe budget constraints. Some states have sophisticated stakeholder involvement processes and involve the public early. Nevertheless, it has been a long process developing state standards. Environmental groups are impatient. Even though the Clean Water Act was passed in 1972, many water bodies haven't felt its impact because state standards and state programs are not in place.

A manager described science integration in the underground storage tank program, which involves a high level of community involvement. In Region 7, states have delegated programs, but tribes do not. Science helps programs get faster clean-ups. States have a backlog. A key issue is determining the clean-up level and the trade-off between the costs of clean-up and the efficacy of clean-up by natural attenuation. Science questions arise with different kinds of contamination, geological issues determining the size and direction of the plume, innovative technologies to clean up sites more quickly and less expensively, and the potential of natural attenuation. As EPA and state resources shrink, there will be a need for more innovative methods supported by science. The manager primarily works and shares information with states. He acknowledged possible merit in involving ORD in these efforts, especially in green clean-ups and use of green technologies.

Another manager commented that the region works well to integrate scientists into decision making, when decisions "hinge on well-known and well-vetted science." Decision makers struggle with novel issues, like Chromium(VI), where EPA does not have a firm toxicity number for drinking water pathways. The challenge is planning ahead for the "science needed over the horizon." An example is vapor intrusion, where EPA needs to develop the science needed in 2, 5, or 10 years.

Managers discussed human resource needs and strategies for addressing them. Several managers noted that "economic hardship has resulted in good opportunities for hiring." Government jobs are attractive and the region has been able to attract experienced scientists with diverse backgrounds, including water quality modelers. In the future, however, each region may not be able to support expertise in every specialized area. Regions may instead develop "centers of excellence" and provide support to other regions.

One manager noted that EPA does not offer scientists a development track within their disciplines. One option is to provide more options for scientists to work outside EPA and return with new ideas and more senior experience.

It has been difficult for Region 7 to identify staff for new, emerging science areas, even with continuous planning. One example is climate change. Region 7 has found it difficult to identify universities that provide a background in climate change to prepare scientists to work at

EPA. A manager asked for SAB advice on human resource planning to address future climate change science issues.

Managers also praised recent improvements in the regional library, which switched back to an EPA- (rather than contractor-) supported effort. The library has improved how employees get journals and articles and access information resources.

The next topic was communication of science to stakeholders. One manager commented that "stakeholders only want to know the bottom line," not EPA's processes for developing needed science. Stakeholders want a number that's predictable. Several participants spoke of the important role played by Region 7's Office of Public Affairs, which helps the region deliver its messages clearly regarding decisions and particular sites. One manager noted that dynamic interaction with stakeholders is healthy and leads to change. Another manager, however, noted that communicating uncertainties is difficult; "as regulators, EPA can't go out with an academic approach -- we have to go out as if we are right." Dynamic interaction with stakeholders leads to change.

Managers described their experience practicing the incident command system for responding to a homeland security incident. For any given threat, EPA would work within that system, which includes state and federal agencies, to identify the relevant expert(s) who can assess the risk in question in a credible way. Trust relationships play a major role in coordination across agencies. It takes time to develop trust, but Region 7, because of its small size, has worked to foster such relationships. Once agencies agree on a message to convey to the public, then the risk communication can happen. Region 7's Public Affairs Office has provided risk communication training. The core principles are to tell people the truth, what's known, keep it simple, keep it short and repeat it. "People are smart and can understand." Representatives from Region 7 attend risk assessment conferences and communicate lessons learned to other regional contacts and states.

A different example involved the challenge communicating EPA's determination that greenhouse gases endanger human health and the environment. Region 7 managers receive many questions about EPA's climate change decisions and find it difficult to respond and integrate the large body of evidence behind EPA's endangerment findings. One manager said that he meets a "tough crowd" and feels "we're not prepared" to communicate polarized science to the public. He also noted that climate change models don't provide information useful at the regional level and involve so many uncertainties, that the science is exceptionally difficult to communicate. EPA's credibility depends on the climate change science generated by other institutions (e.g., the World Resource Institutes, Intergovernmental Panel on Climate Change). Regional managers depend on the Regional Science Liaison for ORD, or the EPA Science Connector to link them to ORD experts who can help them field detailed questions.

EPA Region 7 Scientist Participants (10:15 - 11:30 a.m. Session)

Mr. Walt Foster, Ecologist, Assessment & Monitoring Branch, Environmental Services Division
Ms. Debbie Bishop, Superfund Lead Region Coordinator, Superfund Division

Mr. Wilfredo Rosado-Chaparro, Storage Tanks & Oil Pollution Branch, Air and Waste Management Division
Mr. Stanley Holder, Program Operations & Integration Staff, Office of Policy and Management Division
Mr. Robert Feild, Special Emphasis and Remedial Branch, Superfund Division
Mr. Dave Drake, Special Emphasis and Remedial Branch, Superfund Division
Ms. Kelly Schumacher, Assessment and Monitoring Branch, Environmental Services Division
Ms. Ann Lavaty, Water Quality Management Branch, Water, Wetlands and Pesticides Division

After listening to the five science integration topics of concern to the SAB, scientists took turns providing insights, based on their experience working in the Region. The first scientist described how Region 7's environmental justice activities have a need to draw on social science. Interactions with communities and the economic impacts of policies are unpredictable and should be studied. EPA has improved how it engages communities, makes increased use of geographic information system census data, and develops more consistent, sensitive methodologies to identify disadvantaged communities, but more could be done. Environmental justice communities are difficult to define, but EPA could make more consistent use of databases to recognize potential disproportionality in health and economic impacts. A science-based approach can help programs address environmental justice needs and benefits. She noted that the current administration is reaching out to local universities to attract diverse well-educated scientists. Scientists with a more diverse background may help advance environmental justice programs.

A regional scientist described working with Tribes in Region 7. He also uses databases to identify problems in tribal lands and trains environmental directors to use them. He collaborates with the Indian Health Services and Bureau of Indian Affairs, working jointly on projects and sharing funding, to address special challenges in Tribal lands: the special economic problems of Tribes; community outreach regarding risks of lead, levels; and the need to communicate science on such topics as pesticides, drinking water, waste water, solid waste, quality control/assurance, healthy homes and children's health so that they can use science in their decision making.

Another scientist provided a 30-year perspective on working on EPA site remediation. He had worked at EPA's Times Beach site shortly after the passage of Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), when EPA didn't have a regional risk assessor, an action level, or a clean-up level. Region 7 adopted the 1 part-per-billion level of concern set by the Centers for Disease Control and the state of Missouri was directly involved in the clean up. Now, as manager of Superfund sites contaminated by lead, he relies on EPA national guidance for an action level and remedy selection. Regions don't typically set their own level. Regional scientists, however, need to stay abreast of the science because of litigation. The ASARCO Lead Smelter site in Omaha, for example, has involved aggressive litigation with the Principal Potentially Responsible Party. Regional responses to the litigation must be based on current science to be supportable at court. As a result, Region 7's risk

assessors have been recognized as the premiere lead risk assessors nation-wide, and have served as consultants for the national, as well as for other regional sites.

The region has also developed specialized expertise in lead speciation, because the Region must demonstrate the source of the Omaha lead. A critical legal issue involves whether the lead contamination was the result of lead-based paint or the ARARCO smelter. EPA has drawn on the expertise of a key expert consultant and Region 7 lead experts participate in a national work group.

Another scientist provided a different historical perspective, describing EPA's evolving efforts to protect ecosystems. It has taken a long time for the public to understand ecosystem impacts and for EPA organizations to adapt and change processes to integrate analysis of ecosystem effects into decision making. He started a remote-sensing group 20 years ago, but decision makers have been slow to use the data for decision making. Emergency response managers use some of the data; enforcement managers sometimes use it, but often there are "tradeoffs between science you think should driving things and the *real politik*" of the decisions actually made.

Yet another scientist responded that regions have developed a process for using science. Regions try to be consistent, transparent, and conservative. They follow policy set by Headquarters and "fear going rogue." There are impediments to doing original science or using new science, because new information may not be peer reviewed or fit with existing policy.

Turning to the water program, a scientist described the differences between working with states to approve state water quality standards (WQS), 303(d) lists, and Total Maximum Daily Loads and working with the national program office on new water quality standards at the national level. Each of the four states in Region 7 has different administrative procedures and procedures for public involvement. When she reviews packages of state WQS regulations, she must determine that there is a scientifically defensible rationale for approving the regulations and that the underlying science is communicated clearly. Regional counsel must concur with the water program when approving or disapproving a state WQS package.

She spoke of the new “Kaizen” water quality standards process Region 7 is implementing; the Kaizen process is a streamlined process for all four Region 7 states and EPA to follow for submittal, review and approval of state WQS’s. The process includes the following:

1. State initiates a scientific scoping meeting with EPA Region 7 and HQ on a specific standard change during which a schedule and timeline is developed for discussing the package, this is also where “scientists close to the issue,” academicians, state scientists, and scientists from non-governmental organizations come to the table with all of their information;
2. EPA consults the US Fish and Wildlife Service and provides science and policy input to the state on the specific standard change;
3. State develops a game plan for how to move the WQS through the standards process which includes background, schedules, milestones, identification of science/data analysis

needs, policy issues, potential stakeholders, issues of national significance and options for solving the issues identified;
4. EPA reviews key action items from the state's game plan and stakeholder process;
5. State develops a draft rule package/consultation package, sends to EPA and EPA reviews;
6. State decides whether to move forward with a formal rulemaking process.

Region 7 and Iowa recently used the Kaizen process to modify EPA's nationally recommended water quality criteria for chloride for adoption in Iowa; this effort may result in EPA revising the national criteria for chloride for the United States

An engineer in the Superfund Program spoke of successes developing and implementing innovative technologies. With the help of several universities in the Region, he piloted a method for re-vegetating a Kansas prairie-type cover over mining waste. The approach worked successfully and he documented it as a clean-up technology. It is now being used on thousands of acres. He also pursued alternatives to *in-vivo* studies of lead bioavailability, because the process is very expensive and involved sacrificing animals. He funded *in vitro* research that mimics the *in-vivo* results. The new *in-vivo* method has become a new standard EPA method with an official method number. He spoke about the creativity and flexibility of his job, "the beauty of being a project manager is that I can begin a financial agreement with states or universities early and can integrate the result into an Agency decision document." Once a technology appears in a record of decision, others can follow it as a pattern. His experience shows how regional science can be integrated into decision making.

He described how he integrated science communication into his work as a Superfund project manager. For every clean-up, he routinely meets with the media and plans for a television appearance. He'll plan on taking a trip to have lunch with community members and build a framework of relationships, an essential part of the process of communicating science. Whether the science is novel or not, he expects to be asked to explain it and have the media scrutinize "what we do." Overall, science has helped him implement solutions to problems.

To get science support, he typically uses cooperative agreements with universities and states, because of the resources offered by such large institutions as the University of Kansas, Kansas State, and Purdue. He also uses ORD laboratories and partners with ORD teams, but does not generally uses consultants directly.

A coordinator for the underground storage tank program described his work as "applied science." Much of his job involves explaining science--to his non-scientific supervisor, to the States, to the Tribes, and to stakeholders. He likes the challenge of communicating science to non-technical people. It helps him to think "outside the box." He also expressed enthusiasm about chairing the Latino Math and Science Academy sponsored by EPA and several academic organizations in Kansas City. He spoke of the need to communicate the exciting possibilities offered by math and science to students not often attracted to these subjects. EPA's investment in science education may help students pursue future careers at EPA and may help the public understand and respect science and EPA's work.

The final program area discussed was the National Environmental Protection Act (NEPA). One scientist noted that NEPA "forces you to be a "jack of all trades -- not a specialist" and that such a role is difficult for scientists. He described two aspects of NEPA: enforcement and compliance. NEPA requires federal agencies responsible for issuing a license or funding a major project to conduct an environmental impact statement. The lead federal agency associated with the activity must assess environmental impacts and make a finding of "no significant impacts" or of "significant impacts." If there us a "significant impacts" finding, the lead Agency must complete a more detailed environmental impacts. EPA "enforces" the NEPA process by reviewing assessments developed by other federal agencies. EPA, in turn, itself must comply with NEPA when, for example, it provides funding for a wastewater treatment plant. In Region 7, EPA's NEPA program primarily involves enforcement.

As part of its enforcement responsibilities, EPA must evaluate and grade environmental impact assessments to determine their adequacy in meeting the intent of NEPA, and the requirements of the Council on Environmental Quality (CEQ) under the section 309 of the Clean Air Act Amendments. If EPA disagrees with the lead Agency's assessment, CEQ makes the final determination. Because NEPA projects can vary widely, Environmental Impact Assessments can be very technical, and EPA has only 45 days to review an Environmental Impact Assessment (with the possibility of a 15-day extension), regional NEPA staff must constantly be reviewing new material and monitoring possible upcoming projects. EPA does not have NEPA staff trained in evaluating assessments for new impacts, such as global climate change, genetically modified organisms, or impacts on ecosystem services; for technologies like nuclear power risks, where EPA's experts have retired; or for new paradigms, such as cumulative risk.

He noted a need for training for scientists responsible for NEPA review and noted that performance standards did not require EPA personnel to keep "up to speed in your areas of expertise" or meet technical requirements for their jobs. Other scientists noted differences across divisions. The Superfund program stands out for the "wealth of training" and travel money available to support professional development. A scientist in the environmental justice program also noted that the Region supported training her training and development. A toxicologist noted that she missed the stimulation of training and new ideas outside the Regional Office. Although the four toxicologists in Region 7 talk actively and she attends meetings with other Regional risk assessors and annual meetings of the Society of Toxicology, she misses more frequent opportunities to keep abreast of new science in such areas as genomics and seminars that introduce her to new ideas.

Region 7 Acting Regional Administrator, Mr. William Rice (12:45 - 1:30 p.m.)

Mr. Rice began the discussion by observing that almost every issue in Region 7 has scientific underpinnings. Different sets of challenges arise when decisions depend on accessing existing information, compared with decisions where needed science is not available.

In most situations, the challenge for managers and staff is to "keep up" with the relevant science. Because EPA has a "stove piped" organizational structure, it is difficult to keep informed about the science across EPA and how science in one area affects another. He noted

the contributions of Region 7's Science Advisor, Brenda Groskinsky, in helping Region 7 access science across EPA and especially in ORD.

In other situations, the Region must make decisions on issues where there is extremely limited available science. He described a specific situation where Region 7 received a briefing from health and technology experts in ORD as well as OSWER's Technology Innovation an Field Services Division. It was extremely beneficial to have direct access to the most current scientific information.

Mr. Rice also noted the major challenges with the science underlying the causes of hypoxia in the Gulf of Mexico. Additional science, is needed to develop effective strategies and to educate the public about the need for nutrient management.

SAB members asked Mr. Rice to comment on how ORD's programs support the region's needs. He responded that the Region 7 Science Advisor has been communicating with ORD's National Center for Environmental Research on possible future extramural grants of interest to Region 7. She is also working with ORD's Corvallis laboratory, with National Science Foundation funding, to study different approaches to controlled burns of tall grass prairie through the use of air quality models, and how different options for this agricultural practice relate to non-attainment conditions under the Clean Air Act. This multi-disciplinary research may have an impact on regulations and policy. In general, however, it is difficult for Region 7 to work through ORD's long-term research planning process to meet regional needs. A better strategy for the Region has been to tap ongoing research that the Region can apply immediately.

In response to a question about the usefulness of SAB reports, such as the 2003 report, *Hypoxia in the Northern Gulf of Mexico*, Mr. Rice responded that it would be helpful for some group in the Agency to take the lead for reviewing such reports and identifying their possible impacts for the Regions. He noted the importance of conferences and workshops that distill science for Regions.

Mr. Rice noted that EPA had offered systematic training in risk communication in the past and called for more future investment in that area.

The discussion closed by addressing human resource needs related to scientific and technical staff. Mr. Rice noted that a recent human resource study identified the need for "multi-faceted" individuals, i.e., scientists who were also good communicators or individuals who could fit multiple positions.

EPA Region 7 Agricultural Team Participants (1:30 - 3:00 p.m. Session)

Damon Frizell, Environmental Scientist / R7 Associate Ag Advisor
Dr. Donna Porter, Environmental Scientist / CAFO Coordinator, Water, Wetlands, and Pesticides Division
Jason Daniels, Environmental Scientist / IA Wetlands Coordinator, Water, Wetlands, and Pesticides Division
Dan Breedlove, Ag Counselor, Office of Regional Counsel

Heather Duncan, Environmental Scientist, Water Wetlands and Pesticides Division
Todd Phillips, Life Scientist / Kansas Pesticide Program Officer, Water, Wetlands, and Pesticides Division

A member of the agriculture team noted that agriculture had become increasingly important to EPA over the past 10 years and will likely become even more important. Region 7 developed the agriculture team to promote communication and education within the regional office to improve interactions with the agricultural sector. Region 7 holds a monthly meeting to share information about activities affecting agriculture across EPA programs. The team also sets priorities and identifies needs related to environmental protection in the agricultural sector on an annual basis. The team also provides an EPA presence in the agricultural community to help members of the community provide early input into regulations that affect them.

Although EPA does not have as strong a presence or the same relationships with farmers and the agricultural community as USDA, EPA is participating in the work of the USDA Cooperative State Research, Education, and Extension Service grant program related to three water quality issues: nutrients and sedimentation, bioenergy, and watershed initiatives.

The agricultural team also deals with some issues related to regulations under Federal Insecticide, Fungicide, and Rodenticide Act. Pesticide drift, for example, causes increasing problems, because urban sprawl brings residential housing close to farm fields. EPA also cooperates with USDA on occasional pesticide residue issues to ensure residues are below health threat levels. Another issue concerns tests for genetically modified plants. As tests become more frequent, farmers sometimes do not comply with requirements for buffer strips to separate genetically modified plantings. The Region 7 Agriculture Team explains the rationales and science behind the requirements to address concerns that "EPA lacks real reasons why we do this."

The Region 7 agricultural team often works to ensure that regulations are enforceable. The Region 7 team, for example worked with the revised 2008 Concentrated Animal Feeding Operation to identify the nutrient management terms to be included in permits.

Members of the Agricultural Team noted that voluntary programs have the most potential for reducing environmental risks associated with agriculture. For voluntary programs to succeed, however, farmers must be convinced of the merit of environmental protection programs. Scientists on the team must have a scientific base to justify programs and give them credibility.

In the wetlands program, there is a need for science that meets the needs at the Regional level to evaluate the quality of wetlands, assess mitigation sites, and predict "what a restoration will look like." Regions need rapid assessment methods. The wetlands program gives grants to states, tribes, and communities to develop the needed science for specific locations. The Regions evaluate whether the resulting science is effective and practical to use and has developed a tracking database for all grants.

Region 7's Agriculture Team has developed science on atrazine needed by the Agency. Because of atrazine reregistration, Syngenta has been monitoring several watersheds. Two

watersheds in Missouri and one watershed in Nebraska exceeded the levels of concern. Headquarters scientists from the Office of Pesticide Programs met with state of Missouri staff, Agricultural Research Service scientists, and scientists from Region 7 and are using information from the Region 7 sites for reregistration. Region 7 has also awarded states grants to evaluate 57 pesticides of interest for effects on sensitive species to establish water quality criteria. In these cases, regional science and networks are contributing to decision making at the national level.

Members of the Agriculture Team described how they try to work with and through USDA programs, especially with state land grant extension personnel, to address environmental issues, but USDA and EPA priorities differ. One member of the Agriculture Team called for more research to be focused on developing and demonstrating field practices, use of cover crops, terraces, and livestock practices that will improve water quality. Demonstration projects that illustrate combined agricultural and environmental benefits are especially important to the agricultural community.

EPA Region 8 Science Integration for Decision Making Fact-Finding Interviews
December 15, 2009
1595 Wynkoop Street, Denver, Colorado

Four members of the SAB Committee on Science Integration for Decision Making (Drs. Catherine Kling and Rogene Henderson in person and Drs. Terry Daniel and Thomas Theis by telephone) conducted three interviews in EPA Region 8. The first interview included a subset of thirteen scientific and technical staff, the second with a group of eight managers and the final interview was held with the Acting Regional Administrator. For each interview, Dr. Anthony Maciorowski, Associate Director of the SAB Staff Office, provided a brief introduction to the purpose of the interview and the Designated Federal Officer, Dr. Angela Nugent, took notes to develop a summary of the conversation. All interviewees were provided a copy of the committee's Preliminary Study Plan in advance.

Dr. Maciorowski noted in each interview that the purpose of the interview was to help SAB Committee members learn about Region 8's current and recent experience with science integration supporting EPA decision making so that the SAB can develop advice to support and/or strengthen Agency science integration efforts. Dr. Maciorowski thanked participants for taking time for the interviews and thanked Ms. Patti Tyler for coordinating the fact-finding sessions with the SAB Staff Office.

EPA Region 8 Scientific and Technical Staff Participants (10:00 - 11:30 a.m. Session)

Mr. Bob Brobst, Environmental Engineer, Office of Partnerships & Regulatory Assistance, Wastewater Unit
Dr. Angelique Diaz, Environmental Engineer, Office of Partnerships & Regulatory Assistance, Indoor Air, Toxics & Transportation Unit Program
Dr. Susan Griffin, Senior Toxicologist, Office of Ecosystems Protection & Remediation, Technical Assistance Unit
Ms. Mary Goldade, Senior Environmental Scientist/Chemist, Office of Ecosystems Protection & Remediation, Technical Assistance Unit
Mr. Karl Hermann, Water Quality Monitoring and Assessment Coordinator, Office of Ecosystems Protection & Remediation, Water Quality Unit
Ms. Marcella Hutchinson, Environmental Scientist, Office of Ecosystems Protection & Remediation, Watershed and Aquifer Protection Unit
Mr. Dan Jackson, UIC Program Energy Coordinator, Environmental Engineer, Office of Partnerships & Regulatory Assistance, Groundwater Unit
Dr. Kristen Keteles, Toxicologist, Office of Partnerships & Regulatory Assistance, Pollution Prevention, Pesticides and Toxics
Mr. Steve Wharton, Risk Assessor, Office of Partnerships& Regulatory Assistance, Solid & Hazardous Waste
Ms. Sandra Spence, Environmental Scientist, Office of Ecosystems Protection & Remediation, Water Quality Unit
Dr. Jim Berkley, Environmental Engineer, Office of Ecosystems Protection & Remediation, Watershed & Aquifer Protection Unit

Ms. Carol Russell, Climate Change Coordinator for Water, Office of Ecosystems Protection & Remediation, Watershed & Aquifer Protection Unit
Ms. Patti Tyler, Science Advisor and Science Liaison to ORD, Office of the Regional Administrator

An SAB committee member introduced the discussion by asking participants to comment, based on their experience in Region 8, on any of the five areas below of interest to the committee:

- Practices for integrating science to support decision making
- Consideration of public, stakeholder, external scientific, and other input in science assessment
- Drivers and impediments to implementing past recommendations for science integration
- Ways program receives feedback on how science is used in decision-making
- Workforce to support science integration for decision making

A scientist began the discussion by describing how Region 8 personnel helped respond to Hurricane Katrina and responded to the Murphy Oil spill in 2006. EPA staff used a decision tree that structured how to evaluate environmental conditions quickly and effectively. The use of science was so effective that EPA staff provided a large volume of information to Federal Emergency Management Agency for action very quickly. Similarly, to address the Murphy oil spill, Region 8 scientists evaluated a complex mixture of diesel, gasoline, and organic compounds and worked with stakeholders to systematically clean up hazards. The systematic approach received positive feedback from stakeholders. EPA has mobilized scientists for emergency responses associated with forest fires through Burn Area Emergency Rehabilitation Teams and has taken a similar approach.

Focusing on a different type of decision, the scientist spoke of EPA's need for more long-term, (e.g."decadal") effects studies of the impact of biosolids pollutants over time. He noted that many current decisions are based only on two-year studies. He spoke of the need for quantitative standards that can help guide qualitative standards in waste water permits. Narrative nutrient standards, for example, and criteria such as "no toxics in toxic amounts" are problematic for permit writers, because they are difficult to interpret and enforce.

Another scientist spoke about science-integration pitfalls in ecological assessment. Based on his experience in three regions and in ORD, he observed that EPA still focuses on human health to the exclusion of ecological concerns. Although EPA has adopted some new ways of thinking (e.g., environmental justice, community involvement, tribal concerns), the Agency is a "long way" from integrating these concerns into rulemaking and site specific decisions. There is a need to bring socio-economic considerations into decisions and more fully incorporate tribal values and traditions. Impediments to integration include EPA's "stove piped" organization that presents barriers to information flow and statutory and regulatory constraints. Regions have a different structure for feedback on science from ORD. Regions do not typically conduct field or laboratory studies and undertake peer review. Instead, for Superfund, the region typically relies on an internal remedy review board, where it is often a "challenge to bring science to the table and get attention." An example from 12-14 years ago was a "beautiful marsh" in Davenport, Iowa, contaminated with lead because of a historical skeet range. Data demonstrated wildlife mortality, but the regional review board did not take action until a

potential human health risk to trespassers was identified. He noted that at a national level, the current dioxin reassessment was driven by human health concerns, despite a large body of evidence showing ecological effects. In general, science supporting human health risks is more readily integrated into waste management and Superfund decisions than science on ecological effects.

Yet another scientist discussed groundwater protection and underground injection decisions. He described groundwater as an "unknown universe," that is, a virtually unseen resource existing in a complex and often unpredictable setting with high lateral geologic variability. EPA is tasked with protecting underground drinking water sources from contamination from injection practices. Decisions, however, are generally based on a random sampling of wells and the core definition of "contamination" is a difficult concept to interpret. “Contamination” basically means any substance not originally present in the groundwater. However, baseline conditions can be difficult to establish using existing data, because the data generally are fairly sparse, even random, especially for very shallow and deep non-production zone aquifers, and it usually exists in fairly limited datasets.

Such groundwater characterization issues become important due to several significant emerging groundwater protection issues related to injection for in-situ uranium recovery, carbon geosequestration, aquifer recharge, and potentially unconventional gas (shale gas) production. Regulating carbon geo-sequestration injection potentially could involve a relatively massive human resource investment to hire and train regulatory agency scientists. To be effective in regulating geosequstration injection, EPA's future workforce must have, and continue to develop and improve, reliable professional capacity to evaluate carbon dioxide plumes in four dimensions (e.g., spatially and through time), over a timeframe of 10-to-200 years, including capability to interpret remote sensing data such as multi-component four-dimensional seismic data, and to evaluate complex groundwater and geological models and geochemical monitoring results. The public generally lacks knowledge about groundwater and groundwater science, so uncertainty, doubt and even fear can make it difficult to effectively communicate the complex scientific evaluations involved in agency data gathering and decision making.

Radiation science in Region 8 was the next topic. A scientist described the challenge that exists in overcoming Region 8 stove-piped programs to work beyond one program on radiation issues and the challenge of communicating complex science, poorly understood by most people, on a "highly political topic." She noted several possible impediments to science integration:

- Highly technical people (e.g., engineers and toxicologists) are managed by "non-technical people" who may not fully understand the technical details of science supporting decisions.
- Because the topic is highly political and the science is often not completely understood, people may use their personal opinion on the topic instead of the scientific data, and the proper integration of science into decision making may be impeded.
- Too often science receives only limited or no peer review.
- Some staff work outside their area of expertise, because of resource constraints.
- Contractors conduct some of the region's technical work, and the region needs to strengthen its science base to fully evaluate contractors' work.

- Limited hiring of knowledgeable radiation scientists/engineers may result in EPA being ill-prepared to address the many technical radiation challenges EPA faces.

EPA radiation scientists have multiple mechanisms for information exchange. There are monthly teleconferences for radiation scientists in EPA laboratories, ORD, program offices, and the regions. Rulemaking workgroups, as for National Emission Standards for Hazardous Air Pollutants for radon emissions from uranium mill tailings, allow opportunities for science to contribute to regulatory development.

The next scientist described her 13-year history in the Source Water Protection (SDWA) and Nonpoint Source (CWA) programs, both voluntary programs. The NPS program has a limited budget and lacks regulatory authority to address non-point sources of pollution to water bodies. The program promotes best management practices based on science. As a watershed coordinator, she evaluates non-point source projects and related monitoring developed by states to determine "if environmental benefits are happening." Although she is a geologist, she devotes most of her time to grants administration. She finds it hard to find time to monitor environmental benefits and expand her knowledge of the science underlying water quality remediation and protection of ground and surface waters.

In contrast, the next interviewee described her intensive involvement in science issues, where she has worked on projects where there are promising but not firm links to decision making. She listed at the start several impediments to science integration:

- EPA as an agency has not invested in hiring new scientific and technical staff and providing existing staff with meaningful technical training over the last 8 years. It is not clear if this is simply an artifact of budget limitations but it has had an impact on staff development and capabilities.
- EPA as an agency appears to lack systematic planning for the science needed to support regional decision making. It is not apparent whether EPA's program offices are organized or structured so that problems are clearly identified and strategic approaches to addressing such problems (problem formulation, analytical planning, development of data quality objectives, formulation of decision rules) are developed, implemented, and communicated to the regions. Hence, EPA as an agency has difficulty in making progress on national issues even when the pollutant impairments or technical issues have been understood for decades (examples include nutrient and pathogen impairments in surface waters). This lack of strategic planning impacts the regions such that we have to address these issues on a case-by-case basis using our own technical assessments (for example nutrient target setting in TMDLs when no nutrient water quality standard is available). This places the burden on the regions to move forward in areas where national policy is undecided leaving us vulnerable and open to legal challenge. One wonders how EPA as an agency will make progress on more difficult problems such as the environmental impacts of endocrine disruptors when we continue to struggle with these older issues.
- EPA appears to have an aversion to political and fiscal risk, but not an equal aversion to environmental risk. She noted that only 4% of sewage treatment plants have effluent limits for nutrients, although the science showing adverse impacts of nutrients is firm and EPA has regulatory authority in this arena.

She briefly described her efforts to assess avian risks from mercury in the Great Salt Lake. Although Utah issued an avian consumption advisory in 2004, the state did not address the Great Salt Lake because there was no approved process for evaluating data. Stakeholders identified a problem. She partnered with the state and the Fish and Wildlife Service to gather and evaluate data on avian impacts and has leveraged resources by using interns to complete an analysis that finds measurable risk associated with avian diet in the Great Salt Lake. She is hopeful that this scoping study will be used to affect water quality decisions, but is not clear about how the decision making process will integrate this new information.

The next interview participant expressed the view that the SAB's science integration for decision making effort did not appear to have a problem statement. In his view, integration, may not be the problem with EPA science, instead it may be its credibility. He suggested that rather than assume what the problem is, a root-cause analysis should be conducted to identify the problem(s) to assure that the SAB study is addressing root causes instead of symptoms. He offered "Questions, Comments, and Suggestions," along with several publications and white papers,* for the SAB to consider. From his point of view, credibility and salience of EPA science and engineering and legitimacy of process are key concerns at EPA internally and with the public. He suggested that the context of EPA's work and thus the criteria for credibility, salience and legitimacy has changed since the creation (1970) of the Agency and that EPA has not explicitly acknowledged these changes and accounted for them in the way it does business. He suggested EPA address the three previously mentioned criteria by:

- Acknowledging that the EPA assumption that the public accepts experts as the sole source of credible information no longer holds.
- Providing clearly written science and engineering policies and approaches as described in the Bipartisan Policy Center Report.
- Making greater use of open and transparent processes with third-party review of science and engineering products in controversial projects
- Enhancing EPA problem solving ability by defining distinctions among science, engineering, policy, and politics in science-policy decision-making discussions.
- Providing well articulated sets of principles and guidelines for the effective use of science and engineering advice in decision making

His remarks were echoed by another scientist who voiced concern that EPA must maintain the transparency of its science to maintain public trust and EPA's credibility. Regional scientists, in her view, need to understand science and decision making and translate science for communities. She expressed confidence that even poor, uneducated communities can help

---

*Bipartisan Policy Center. 2009. Science for Policy Project; Interim Report

Government of Canada. 2000. A Framework for Science and Technology Advice: Principles and Guidelines for the Effective Use of Sciencedۡ and Technology advice in Government Decision Making. CAT.No. C2-500/2000

Cash, D., et al. 2002. "Salience, Credibility, Legitimacy, and Boundaries: Linking Research, Assessment and Decision Making." John F. Kennedy School of Government, Harvard University, Faculty Research Working Papers Series

Ludwig, Donald. 2001. "The Era of Management is Over." *Ecosystems* 4: 758-764.

Pielske, Roger A., Jr. 2007. *The Honest Broker; Making Sense of Science in Policy and Politics*. Cambridge University Press

make sound decisions when they understand the central principles and findings underlying EPA science. As an example, in the Animas watershed, a stakeholder process was used for developing science-based TMDLs. To maintain this transparency, regional scientists and decision makers must have access to the full scientific assessment for a chemical and be able to describe uncertainties. An example is metal toxicity. It is important to look at different metal compounds, bioavailability, and speciation because different metal compounds behave differently in the environment. Regional decision makers can make more effective, practical decisions, if they can take more complete risk information into account. In her view, EPA needs to be more resilient and respond to changing issues and science more quickly to provide the information regions truly need.

The next scientist also focused on risk assessment and science integration issues for regions. Although EPA scientists are excellent and EPA has published outstanding risk assessment guidance, EPA's National Center for Environmental Assessment has not provided the scientific information needed with respect to the IRIS Program. "Program offices pick and choose science to protect their decisions and strip out uncertainties, all in the interest of a corporate culture of control and consistency." One example is carbon tetrachloride. The SAB reviewed EPA's draft assessment and identified pros and cons concerning the use of linear defaults, but the final IRIS file simply included discussion of the linear default. Because the resulting assessment was simplified and does not follow EPA's 2006 cancer guidelines, EPA regions lost access to key science and the flexibility to use it for decision making. Citizens in communities want to negotiate novel approaches to address environmental problems that can abate environmental hazards and meet economic and social needs, but regions are limited by the risk assessment information provided by national programs. Regions are capable of communicating information about variability and uncertainty to communities. Once these nuances are communicated and understood, many new options are possible. "When we are just given a number, all this is taken off the table."

Ecological assessment was the topic of the next speaker who reaffirmed a previous scientist's observation that EPA still focuses on human health to the exclusion of ecological concerns and noted science integration opportunities for EPA to gather ecological data for ecological risk assessment while it collects human health data. Economies of scale would be possible, if a more integrated approach were planned and implemented. She provided a long list of impediments to science integration:

- She echoed concerns about reduced technical training and expertise in the region and sensed a "vise-grip stunting" the region's scientists.
- She voiced distress that her unit has a policy that no one can attend a professional conference without presenting a paper, a policy that stifles information exchange and personal growth.
- Region 8 has an increasingly limited number of scientists available to support the inherently governmental function to review contractors' products to ensure that they support EPA's decision making needs and meet guidelines and science policy.
- Region 8 does not consistently get "Scientists to the table" when decisions are made. Only project managers who appreciate science input ensure that scientists are involved.
- Difficulties accessing ORD science and getting support for regional issues.

The next scientist offered a cross-regional perspective based on prior experience in Region 1. She noted that Region 1 has incorporated ecological risk assessments in decision making especially related to site-specific hazardous waste sites and consistently brings scientists from different disciplines to the table when decisions are being made. Region 1 has a strong commitment to its Regional Science Council, which facilitates science integration across regional programs and activities.

Region 8 does have a regional science program that offers opportunities for integrating scientific information into programmatic decision making. ORD's regional science program sponsors the Regional Applied Research Effort (RARE). Regional Methods, Regional Science Workshops, and theRegional Research Partnership Program (RRPP). RRPP is an opportunity for a regional scientist to participate in a short term training opportunity at an ORD laboratory or center.

She also noted barriers to science integration. She agreed that ecological risk assessment does not receive the same weight or attention in decision making as human health assessment. Efforts to develop an approach to cumulative risk have taken "way too long." EPA has delayed developing approaches for evaluating non-chemical stressors. Other impediments include:

- Lack of sufficient training funds.
- Need to increase expertise in decision sciences.
- More effective mechanisms to resolve differences among technical staff in Region 8 on science issues.
- Lack of understanding about where the regions fit into the "ORD transformation" being planned and a need for a formal collaborative process to demonstrate an equal partnership between ORD and the regions.
- More ORD attention to regions' needs for technical support.

Emerging science and EPA's lag to keep up was the focus of the next speaker. She noted that emerging science related to endocrine disruptors highlights the role of timing of exposures, but current regulations don't take this factor into account.

She also called for EPA to take a life-cycle or "precautionary" approach before it supports new technologies or new uses of chemicals. Tire crumb, for example, should have been evaluated more fully before EPA supported its use for children's playgrounds and ball fields. Stove piping and lack of communication between program offices prevents EPA from conducting a full life cycle risk assessment "up front." The result is a costly effort "*post hoc*" to assess children's exposures to tire crumb waste, a problem that could have been prevented. She also expressed the view that science exists to support an EPA approach to cumulative risk and voiced concern that some Agency products, like the National Air Toxics Assessment, were influenced more by politics than by science and do not include recent science.

The final scientist participant spoke of his role using science in EPA's water programs supporting states' 303(d) and 305(b) listings. He expressed concern that ORD has abandoned some activities like Environmental Monitoring and Assessment Program, which benefited Region 8 and the states. He spoke of the importance of stakeholder processes in strengthening science for environmental protection. Colorado has a strong and meaningful process that

allows stakeholders to raise questions about EPA science. As a result, Region 8 scientists are "pushed to do better science," to use all available scientific data, and to evaluate the data from different perspectives.

EPA Region 8 Manager Participants (1:00 - 2:30 p.m. Session)

Dr. Mark Burkhardt, Director of Golden Laboratory, Office of Technical and Management Services
Ms. Karen Hamilton, Chief of the Water Quality Unit, Office of Ecosystems Protection & Remediation.
Ms. Deborah Lebow-Aal, Manager of the Indoor Air, Toxics and Transportation Unit, Air Program, office of Partnerships & Regulatory Affairs
Ms. Nancy Morlock, Manager of the Corrective Action Unit, Solid & Hazardous Waste Program, Office of Partnerships and Regulatory Assistance
Dr. Deborah McKean, Chief of the Technical Assistance Unit, Program Support, Office of Ecosystems Protection & Remediation
Ms. Melanie Pallman, Program Manager of the Pollution Prevention, Pesticides & Toxics Program, Office of Partnerships & Regulatory Assistance
Ms. Sandra Stavenes, Program Manager of the Wastewater Unit, Office of Partnerships & Regulatory Assistance
Ms. Patti Tyler, Science Advisor and Science Liaison to ORD, Office of the Regional Administrator

SAB members asked managers to describe their decision-making practices, the decisions made in their organization, and the role that science plays. Managers were also asked about the processes for public and stakeholder involvement, impediments to bringing science into decision making, and work force issues that affect science integration into decision making.

One manager described the Superfund program and described the Libby Montana site as the exemplar. Her unit includes toxicologists, hydrogeologists, and modelers, who respond when a remedial project manager requests technical support. Libby is a large and complicated site that will have far reaching implications on other asbestos sites. Key decisions are made throughout the analysis process: in the development of sampling and analysis plans, definition of exposure, choice of toxicity factors, and exposure factors. The region typically convenes a technical work group with risk assessors from OSWER, other regions, and ATSDR for peer review of technical documents like sampling and analysis plans. If the community feels methods are insufficiently sensitive, the region seeks their input so that site-specific investigations can include local knowledge. The regional team holds public meetings on a regular basis to provide progress updates to the community. The analysis might "pull in a number" from IRIS, but if the region feels that the IRIS toxicity values are not relevant, site-specific studies will be conducted such as animal laboratory studies to derive a site-specific cleanup standard.

She has not had much experience with retrospective assessments and the use of science in Region 8, but did describe her experience with past Incidents of National Significance and partnerships with the National Homeland Security Research Center (NHSRC), CDC and

Department of Homeland Security in an effort to develop a "more scientifically based clean-up goal rather than a non-detect level" for anthrax. NHSRC sought an approach that would provide a scientifically-based, yet cost-effective clean-up goal that included the involvement of the local public health and community members, this protocol was reviewed by the SAB.

The next manager reflected that science integration was not difficult for the water quality program. Data limitations, instead, were the principal issue. Developing nutrient criteria on an eco-regional basis is resource intensive, yet essential. The science is enormously complex and costly to establish nutrient criteria When EPA requires wastewater treatment plants to reduce nutrient emissions, green house gas emissions go up, and EPA "scrambles to research that question" with limited resources. Sometimes interns and volunteers fill the gap. Her staff attempts to fill the gap but it's "a struggle." There are limited funds for professional development and conferences. Travel funds are typically reserved for providing technical assistance or investigation.

She described a controversial science integration issue involving generation of a selenium water quality standard for the Great Salt Lake, one of the few efforts to develop a selenium water quality standard specific for that water body. The state of Utah, working with stakeholders, developed a standard based on a scientifically sound study of this unique water body by a panel, noted selenium experts who gathered specifically for this 4 year, $2.5 M research study. EPA has provided support through grants and workgroup participation, but has not yet approved he proposed standard because the Fish and Wildlife Service (FWS) alleged EPA would violate the Migratory Bird Treaty Act if it approved the standard. The FWS advocates a stricter standard (in part based on a no-effect concentration vs. an EC 10 concentration) and views the state's (an approval organization) proposed standard as allowing a "taking" of birds.

The next manager described how RCRA decisions rely on risk information. The Region 8 states are authorized for RCRA and with the exception of a few sites in the region that are being directly implemented by EPA. The states have the lead for RCRA. The region's role is technical assistance and oversight of the authorized state programs. EPA provides staff support or contractor support to the states on issues such as groundwater modeling and risk assessment as requested. Each year, Region 8 reviews a sample of state decisions to evaluate appropriateness and efficacy. The RCRA process mandates public involvement; some states provide opportunities for substantial public involvement.

Several managers commented on retrospective assessments of science used for decision making. A manager noted that the Superfund program has a review requirement of decisions as part of each site's five year review. The Superfund Remedy Review Board conducts these reviews to ensure national consistency. Another manager noted that there is a requirement for water quality standards to be reviewed every three years to incorporate new science. The public has the opportunity to bring new science to the table and new science also can come from ORD. The Agency has been inconsistent in meeting this requirement. A manager noted that in the last administration, states had no triennial review for three cycles.

Several managers noted that EPA receives criticism whenever it makes a decision and that the level of controversy doesn't depend on whether bad or good science is used. It was noted

that if the scientific information is available, EPA is eager to use it. EPA's science is strong but the transition to policy appears to be more challenging. SAB members asked whether additional investment in science communication would be useful. Managers responded that effective communication and lack of public understanding were not the key issues. There is controversy when people don't like EPA's decisions. One manager expressed concern that given limited budgets for research, it may not be wise to invest in risk communication.

An SAB member asked managers to comment on Region 8 staff concern that contractors are increasingly tasked with scientific work and that staff do not have the time or sometimes the expertise or appropriate software tools to evaluate contractor's work. Managers responded that Region 8 programs have project officers responsible for implementing quality assurance/quality control processes to review contractor's work.

Managers discussed the role of science in controversial issues. One manager noted that EPA is generally confident about its science. In the case of the Utah selenium standard for the Great Salt Lake, the policy issue is the focus of controversy, not the science. Another scientist spoke about "dueling science" at the Pavillion Wyoming site involving hydraulic fracturing perspective production zones. Chemical analytical tools can be used to determine the presence of constituents and can be further uses in case preparation. Another manager spoke about the misalignment between radiation science and implementation of outdated guidance that make revising radon standards difficult. Federal programs have internal struggles over interpretation and implementation of existing guidance. Another manager spoke of "dueling science" concerned with the "woody biomass issue" involving air quality issues associated with fuel burning, where there is a paucity of data, outdated policies in which a definition of carbon neutral is needed. These issues have resulted in disagreements between EPA and the Forest Service.

Managers spoke of the need for new ways to interact with ORD. One noted that ORD scientists are specialists, but that Regions have broad research and data needs. Many key regional needs don't fit within ORD long-term research plans. Other managers acknowledged this as a long-term issue. In general, if ORD science exists to help address a regional issue, Region 8 will use it. Otherwise, Region 8 uses its "own resources" to obtain the scientific information or conduct the necessary research.

One interviewee called for more strategic thinking at EPA on science issues. There's a need to anticipate the need for scientific data, so toxicology and other sciences can be ready to assist decision makers in making policy decisions. For example, a recent concern arose about the problems of PCBs in caulk in one of the other EPA regions. In Region 8, no monitoring has been done to determine whether or not PCBs in caulk is a problem in our region. Therefore, we may or may not be making decisions which adequately protect the regulated community. Another example is the limited information we have about the blood lead levels in tribal children. If more information was available concerning the tribal children's blood lead levels then we may be making different decisions on funding tribal lead programs. In the past, the lead program has made additional funding available where blood lead levels are high; however, areas where blood lead levels have not been tested have not received adequate funding. EPA is using

science in decision making, but there is the need to have that science available and EPA has not had adequate funding to ensure that this science is always available.

Some managers discussed possible new approaches to providing the science regions need. One manager proposed cadres of national experts devoted to particular topics. A directory of EPA's expertise was also recommended. Region 8 could identify its particular expertise niche, such as metals toxicity. Another manager spoke of Cooperative Research and Development Agreements (CRADAs) that permit regions to identify needs and collaborate with ORD and external experts. Such agreements result in usable products and foster relationships among experts. He also suggested that EPA plan for succession and encourage GS-13 scientific staff to build relationships with ORD scientist to maintain their technical expertise.

The last manager discussed the disconnect between the regional programs and regional laboratories and noted that regional laboratories are not tapped as scientific resources, as a "regional asset." The technical input of the laboratory scientists is not always considered. There is a need to monitor and develop new analytical methods for emerging chemicals, such as pharmaceuticals, personal care products and endocrine disruptors. He noted the need to balance between the short term and long term needs and his goal of having "resident metal experts," reducing the need to "chase down ORD experts." However, this collaboration within the region would require lab involvement in project planning, strategic focus on priorities and team building.

Discussion with the EPA Region 8 Acting Regional Administrator, Ms. Carol Rushin (3:00 - 4:00 p.m. Session)

The Acting Regional Administrator reflected on her 25 years in Region 10 and Region 8 focused on implementing environmental regulations and policies. Almost every implementation action involves science. Some actions are informed by established methods and collection of data and others involve scientific information that is "less than clear," such as narrative standards and conflicting opinions surrounding the interpretation of the science, i.e., "dueling science."

Science does not always introduce clarity and a bright line. For example, in the air program, Region 8 evaluates criteria for evaluating the complex science (in air monitoring, modeling, meteorology, the demographics of changing population growth rates, and economics) in state implementation plans (SIPs). Even with the good processes in place, there remain disagreements when evaluating the weight and importance of the criteria, due to the significant economic impacts SIPs can have.

Community involvement is a requirement when determining decisions for Superfund sites and there are times when the community objects to a decision despite the high quality science or the state's acceptance. She noted greater confidence in making those decisions when site-specific data has been collected and alignment exists between the viewpoints of the regional and national scientists. She commented that more attention to social sciences might assist the region to better assess community interests earlier in the process.

She feels most comfortable when the region makes site decisions using site-specific data that represent local conditions rather than having to depend upon default values. As an example, ambient air and blood lead levels were collected at a site in which the community voiced concerns about children's blood lead levels. The region investigated the downward trend of lead concentrations in ambient air and blood for over 10 years and ultimately found the strongest exposure pathway from airborne emissions. The region had the necessary time and resources to study and complete the assessment.

In the absence of site-specific data, EPA uses default values that are difficult to explain to communities. To communicate science effectively to communities in such cases, we establish interactive relationships, build trust, and share data and progress updates on a continual basis The ideal scenario is to engage the community throughout the process. Such an approach is working well at a Wyoming site, where the region has developed a communication strategy and shares analytical results with the community on a regular basis to respond to environmental question posed by the community. EPA has had the money, time, and technology to explain findings and uncertainties. Region 8 has had more mixed results at the Libby, Montana site, where EPA initiated their investigation following reported adverse health outcomes, cases of asbestosis and mesothelioma. One of the technical challenges has been the inability to measure amphibole asbestos. However, risk management objectives were clearly defined during clean-up formulation and many removal actions have already been completed to reduce exposure. Toxicological and epidemiological studies along with activity-based sampling are currently being conducted to support the derivation of risk-based cleanup levels that are protective of human health and the environment. The community is pressing EPA to develop a cleanup level, but currently the region does not have the necessary toxicological information. Region 8 has invested considerable resources towards the remedial investigation of this site. It has stationed staff to live in the community; funded contractors to conduct activity based sampling; and funded a grant for a physician to conduct an epidemiological study. The community is impatient with the uncertainties and "just wants a green or red light."

Ms. Rushin noted that when the Region uses standard Agency toxicity values, there is less focus on uncertainties, although regional managers and scientists realize that the values change over time when new scientific information or data becomes available. As a manager, she realizes that "a lot of up-front work" goes into developing health-protective national standards; and, as a result, she is confident about these values.

SAB members asked Ms. Rushin to comment on aspects of the scientific and technical workforce that may need attention. The Acting Regional Administrator responded that Region 8 has a fairly senior staff, with individuals who have the ability to synthesize decades of work. It is a challenge to strategically hire so that bright new staff can work in tandem with those retiring, to gain their institutional knowledge. She spoke of the need to collect environmental data that can be stored in accessible databases and used to meet multiple purposes to validate modeling and strengthen our decision making. She suggested the Office of Research and Development and Office of Environmental Information as leaders for this activity.

EPA Region 9 Science Integration for Decision Making Fact-Finding Interviews
January 6, 2010
75 Hawthorne Street, San Francisco, CA

Four members of the SAB Committee on Science Integration for Decision Making conducted three interviews in EPA Region 9: Drs. Gregory Biddinger and Lauren Zeise in person and Drs. Wayne Landis and Barton H. Thompson by telephone. For each interview, Dr. Vanessa Vu, Director of the SAB Staff Office, provided a brief introduction to the purpose of the interview and the Designated Federal Officer, Dr. Angela Nugent, took notes to develop a summary of the conversation. All interviewees were provided a copy of the committee's Preliminary Study Plan in advance.

Dr. Vu noted in each interview that the purpose of the interview was to help SAB Committee members learn about Region 9's current and recent experience with science integration supporting EPA decision making so that the SAB can develop advice to support and/or strengthen Agency science integration efforts. Dr. Vu thanked participants for taking time for the interviews and thanked Drs. Winona Victery and Eugenia McNaughton for serving as liaisons with the SAB Staff Office in planning the interviews

EPA Region 9 Deputy Regional Administrator and Senior Managers (9:00 - 10:00 a.m. Session)

Ms. Jane Diamond, Deputy Regional Administrator
Ms. Alexis Strauss, Director, Water Division
Mr. Keith Takata, Director, Superfund Division
Ms. Loretta Barsamian, Deputy, Management and Technical Services Divisions

The Deputy Regional Administrator began the discussion by describing overall strategies to ensure science integration. Region 9 wants its work force to represent diverse disciplines and has recently hired scientists to ensure fresh scientific perspectives in programs and the regional laboratory. It supports an active Science Council that identifies region-wide science priorities and gaps on an annual basis. The region promotes competition for ORD-funded Regional Applied Research Efforts (RARE) grants, which provides $200,000 per region per year for short-term regional research needs. Region 9 also participates in the regional methods program, a total of $600,000, available for methods development in all 10 EPA regions.

The manager of the water division described working with the four states, three territories, and tribes in Region 9. Region 9 is a co-regulator with state and sub-state/regional organizations. Science enters the process at different levels. The national water program sets standards for chemicals at a national level for the Clean Water Act and Safe Drinking Water Act. These standards are science-based regulations that all states depend on and that EPA depends on for regulating state, tribal, and territorial waters. The national program office is not able to meet regulatory mandates, the water quality criteria (CWA) and Maximum Contaminant Levels (MCLs) (SDWA) on which states and regions rely. She noted that emerging contaminants is a category of chemicals in which ORD is invested but EPA has not yet determined how to regulate.

In addition to national standards, regions need the national program office to promulgate implementation guidance for CWA and SDWA standard setting. Implementation issues can be quite controversial, because of compliance burdens for small operators and small metropolitan areas." The regional manager described how drinking water programs from all 10 regions mobilized to send a consensus letter asking the Office of Water to issue implementation guidance for methyl mercury before the Office of Water issued that critical guidance. She also described another example, implementation guidance needed for arsenic treatment. Several tribes and small communities in Region 9 have built treatment plants but cannot afford to operate them. She noted that the Administrator is calling for the Agency to be bolder, but "timidity" in program offices regarding standard setting and implementation guidance prevents regions from moving quickly to address water contamination.

She highlighted the importance of providing environmental information and science to the public in meaningful ways and praised publications by the Southern California Coastal Water Research Project, which does a "spectacular job" of issuing data the public can use. She noted that EPA has lost its ability to produce similarly high quality publications. EPA scientists tend to have "inside conversations" within the federal government and with academicians, but do not effectively translate science into publications or on-line data that reach a public audience. EPA tends to focus its science communication and science education reactively, e.g., when the New York Times publishes articles on turbidity. Another manager agreed that it is exceptional when EPA releases a high quality product that effectively communicates science to the public. One recent example is a public service announcement that educates children about mercury dangers.

Stakeholders in water programs tend to have very localized interests. Ninety-eight per cent of grants go to state water boards, tribes, and territories, with very little other discretionary money for local stakeholders. The interests of state watershed groups are highly localized and water quality issues are state-wide issues. Where there are public listening sessions, for example, an upcoming storm water listening session, the public will be able to discuss future directions of the storm water program, but it is unclear how those ideas, many of which are likely to have merit, will influence the future direction of the program.

The next topic was science integration within the context of the Superfund program, a program that focuses on reacting to identified problems either in the context of a large clean-up site or emergency response. The Region 9 Superfund program manager shared a cartoon (Attachment A) that symbolized his program. The Superfund program generates a lot of science, but yet, given all possible risks, the science is limited and has many uncertainties. He often wonders what problems are missed, but can't delay Superfund actions to find out.

The regional Superfund program needs scientists who can make practical decisions "on the spot" and who can effectively explain decisions and supporting science to the public. In many cases, the program can wait for science and research to develop, and so it is difficult for the region to depend on ORD to provide answers within a short-time frame. The Region 9 Superfund program has a technical team of 10-11 people that includes toxicologists, who play a valuable role.

Controversial science issues involve new chemicals and "new science issues related to old chemicals," e.g., how to address a new dioxin number in the context of new clean-up decisions and whether to revisit clean-up decisions in older sites. Where it can develop useful information quickly, Region 9 conducts some research, such as activity-based sampling for asbestos exposures. Such activities are difficult, controversial, and expensive. Another example is indoor air sampling related to vapor intrusion. He expressed concern that decisions get complicated with trichloroethylene (TCE), where he is not sure that the toxicity number is stringent enough, but there is a need for immediate action.

In response to a committee member's question about site redevelopment and possible use of benefit-cost information and information on committee values, the manager responded that his program makes decisions based on community acceptance and reasonably anticipated land use. He did not consider these factors as science-based. He does consider net benefit assessments for sites by using a model that considers multi-factorial considerations, but he did not consider those analyses in an "academic way." He noted that EPA's Brownfields clean-up program focuses more than the Superfund program on potential re-use issues.

For Superfund sites where Region 9 has the lead, community involvement coordinators plan interactions regarding science issues. Community interest in science varies widely. Some sites have no interest; other sites have a huge community involvement process, with community involvement committees, Technical Assistance Grants, or contract mechanisms that help communities contract with local universities for science support.

SAB committee members asked managers to identify where they would ideally like to add science expertise or information to support their programs. Managers agreed that EPA needs scientists to set national standards to support the water and Superfund programs. EPA's central role in updating the science underlying national standards is critical for bringing about consistency across state standards. One manager noted that EPA may not need additional resources; it needs more focus and emphasis on setting national standards as an overall priority.

Interviewees voiced frustrated with ORD's annual planning process and documents. The planning documents are hundreds of pages long and difficult to understand. Region 9 does not understand how regional comments are factored into the process or addressed in the planning documents.

Managers described how their programs cope with changing science. They expect risk numbers often to go down and have a process to plann for those potential changes. The Superfund program, for example issues site-specific decisions allowing for more flexibility when managers anticipate changes in a risk number. The water program can allow for implementation period of five years, allowing for a phase-in period for technologically expensive controls. The manager of the water program noted that her staff is working with the Southern California Wetlands Recovery Project on new measurement methods related to beach pathogens. She expressed confidence that the region can deal effectively with new science and policy issues.

EPA Region 9 Managers (10:30 a.m. - 12:00 p.m. Session) Participants

Mr. Steve Armann, Chief, Permitting and Corrective Programs, Waste Management Division
Dr. Harold A. Ball, Chief, Technical Support Section, Superfund Division
Ms. Brenda Bettencourt, Laboratory Director, Management and Technical Services Division

Mr. Kerry Drake, Associate Director, Air Division
Ms. Kathleen Goforth, Chief, Environmental Review Office, Communities and Ecosystems Division
Ms. Janet Hashimoto, Chief, Standards and TMDL Office, Water Division
Mr. Tom Huetteman, Associate Director, Waste Management Division
Ms. Cheryl Nelson, Chief, RCRA Facilities Management Office, Waste Management Division
Dr. Matthew Lakin, Acting Chief, Air Quality Analysis Office, Air Division
Ms. Corine Li, Chief, Drinking Water Office, Water Division
Mr. Ben Machol, Chief, Clean Energy and Climate Change Office, Air Division
Dr. Eugenia McNaughton
Dr. Lynn Suer, Chief, California Site Cleanup Section, Superfund Division

A regional scientist noted that regions had collaborated on a "45-Day Study" several years ago that raised issues still relevant to regional needs for scientific tools. He noted that regions increasingly have problems accessing tools and expertise. ORD priorities diverge from regional needs, and regions have less access to contractors because of declining budgets.

He asked the SAB to consider how EPA can meet its science needs to support traditional regulatory programs, as the Agency also assumes responsibilities to protect against climate change and address sustainability issues. As environmental needs change, EPA must have the science to drive smart investments in the private sector, and state and local government. He spoke of the need to invest in strong lifecycle analysis methods to make better choices. He noted a strong need to set standards for green products, where the scientific framework is not strong. Another scientist said that the Society for Environmental Toxicology and Chemistry has sponsored sessions on lifecycle analysis for 10 years and that other countries use lifecycle analysis. Scientists looked to ORD to synthesize available information so it could be more useful for regions.

A scientist spoke about the intensive use of science in the water programs. She expressed concern that some existing water quality criteria may not be sufficiently protective. Her division evaluates state standards to check that they are adequately protective. Her division reviews the state of the science and takes stakeholder input into consideration. She finds that she often does not have internal resources to evaluate state standards. In those cases, she draws on her networks, built up over decades, to help bring in the science needed.

A manager from the air quality program described the regulatory program as "data rich" and observed that more money and science would help voluntary programs. He noted that Region 9 presents special problems that ORD and Headquarters science has not been designed to address. Some areas designated as "nonattainment" have been caused by windborne dust, due to unusual meteorological conditions. Because the regulatory language is "fuzzy," problem definitions often aren't clear enough to guide useful scientific enquiries. He spoke of the need to spend more time "problem scoping, identifying real questions." Sometimes statutes or regulations don't "lend themselves" to scientists working with a multi-stakeholder process to identify the core questions. Regions have guidance and latitude for making nonattainment decisions but often do not take the time to fully scope the issue. "Defining question up front is not built into the culture." Deadlines and political pressures force decisions. Sometimes it seems like there are "three months of briefing and one week of analysis."

The drinking water program provides a contrast. It has "set protocols" that are very prescriptive. It is a public health program, and "people don't question the validity of safe drinking water." It is a data rich program. Where data uncertainties have been identified, the public raises questions about water contamination. It is difficult to communicate about risk, because the public is anxious about contamination they hear about through the media. She called for increasing education for the public about environmental risk assessment. In her view, science increases the drinking water program's effectiveness.

Scientists noted that Region 9 had a history of Agency leadership in risk communication, but hadn't held training lately. A scientist described the core approach of that training as being "committed, open, present, and empathetic," and acknowledged the training as a "kind of social science that raised awareness of qualitative input from stakeholders." Another manager noted that EPA has needs to communicate science to other scientists and the general public. Everyone at EPA should "tune into the audience" and present scientific rationales for Agency decisions appropriate to the audience. One manager said that EPA should "absolutely" invest in the social science involved in communicating science, because EPA us "increasingly asking the public to make life choices" that affect climate change and sustainability. Communication becomes increasingly important as the public has more data and information to deal with.

A manager noted that communications become difficult when stakeholders and the public view the environment holistically, while EPA "stovepipes" its programs and problem solving. As a result, a regulatory change becomes a venue for many "non-relevant issues to play out." An environmental activist, for example, used a permit as a "hook" to discuss "cleft palate births" more related to lack of health care or possibly parents working as farmworkers. To communicate effectively and solve environmental problems, EPA needs to partner with others to address the public's real issues. Another manager noted that EPA scientists and representatives may need to learn how to communicate its ongoing presence, the available science, and EPA's constraints "without whining or communicating we don't care." Another manager acknowledged the need for social science tools to help people bring their values and concerns to the table and the need for effective cumulative risk tools.

Agency managers asked the committee members for clarification of its use of the term "science." The SAB staff director responded that the committee was interested in all the specialized scientific and technical information supporting decisions and EPA's processes for planning, generating, and providing that information to decision makers and evaluating its effectiveness.

One manager noted that the water quality program has "tons of nutrient water quality information" that do not help regions establish bright lines defining good water quality standards. EPA may not understand how specific ecosystems function well enough to establish regulatory requirements for a healthy ecosystem. Even with a data-rich environment, for example, EPA doesn't know enough about how hypoxia works to use regulatory tools to establish system response indicators. Having a single nitrogen or phosphorus number may not be useful. The public looks to EPA as experts. Region need to integrate across multiple

disciplines to help us identify standard that are meaningful and help us achieve their mission. The state of the science may not yet exist to support numerical standards for decision making.

The manager described how she might build a systems model for nutrient flows at a spatial scale useful for the regions. The SPARROW model might be transferable to different scales but would need to be validated. The region could attempt this modeling, but would need tools and resources.

A manager noted that Region 9 used science to prioritize actions, e.g., enforcement actions or grants. "The more we're aware of what science and data are telling us, we can make better decision across the board."

A manager from the Superfund program noted that Remedial Project Managers (RPMs) are "dogged" about finding technical expertise to support decisions. They look internally and look to states, academics, Headquarters, and their personal professional networks. Region 9 staff are very knowledgeable and "very plugged in at the national level." The region "triages well" to manage resources. He also noted Region 9's comparative advantage, relative to other regions. Region 9 draws on science available in the state of California and on experts in regional universities. They also spoke of the value of their organization, which places technical staff within program divisions. The Superfund program also fosters collaborative decision making. Technical staff is at the table when decisions are made to ensure that decisions are technically supportable.

Managers spoke about the need for more science investments in emerging contaminants, despite the lack of a regulatory framework. ORD research could help the regions prioritize activities relating to emerging contaminants. He noted the value of possible reform of the Toxic Substances Control Act and the "fantastic science resource" of the Office of Pesticides and Toxic Substances, which is "pretty invisible" because of confidential business information restrictions and history of the program.

A manager spoke of Region 9's need for technology that will be needed to enable the State of California to attain the National Ambient Air Quality Standard (NAAQS) for particulate matter and ozone, in addition to California's "heroic efforts" to control air pollution. EPA signed a Memorandum of Agreement to accelerate the development and deployment of air pollution control technology the California Air Resources Board, the San Joachin Air District, ORD's National Risk Management Research Laboratory, and OAR's Office of Air Quality Planning and standards and Office of Transportation and Air Quality. There are plans for two place-based technology demonstration platforms (one near the coast and another in the San Joachin Valley. Factors involved in choosing sites included environmental justice considerations, proximity to a port, movement of goods and materiel, history of relationship-building with local communities, and possibility for demonstrating new technologies. The project will also include consideration of air toxics and emissions inventory and use of results from a social vulnerability analysis developed through a RARE grant (the vulnerability analysis index helped the Region frame questions to be asked in the study) The manager noted that SAB support for such a local research and demonstration project would be helpful.

Managers spoke briefly about the role of the regional science council and regional science team. The Regional Science Council develops an annual science plan; provides a forum for regional scientists to talk about their work; organizes classes, seminars, and speakers' presentations; and follows up on Headquarters-generated science action items. The team also supports scientists in developing RARE grant applications and prioritizes the applications.

As a last point for discussion, one manager asked how the committee will address whether states have sufficient science. Committee members noted that this topic is an important one that might be addressed at the committee's workshop, tentatively planned for May-June 2010.

EPA Region 9 Scientific and Technical Staff (1:30 p.m. - 3:00 p.m. Session) Participants

Ms. Katherine Baylor, Hydrogeologist, Corrective Action Office, Waste Management Division
Dr. Debra L. Denton, Environmental Scientist, Monitoring and Assessment, Water Division
Mr. José García, Environmental Protection Specialist, Immediate Office, Communities and Ecosystem Division
Dr. Gerald Hiatt, Senior Risk Assessor, Technical Support Office, Superfund Division
Dr. Meredith Kurpius, Environmental Scientist, Air Quality Assessment Office, Water Division
Dr. Bruce Macler, National Microbial Risk Assessment Expert, Drinking Water Office, Water Division
Mr. Kevin Mayer, Environmental Engineer, CA Cleanup Site Section 2, Superfund Division
Mr. George Robin, Environmental Engineer, Underground Injection Control (UIC) Program, Ground Water Office, Water Division
Dr. Daniel Stralka, Environmental Scientist, Technical Support Office, Superfund Division
Mr. Max Weintraub, PCB Coordinator, Toxics Office, Communities & Ecosystems Division
Dr. Winona Victery
Dr. Patrick Wilson, Toxicologist, Corrective Action Office, Waste Management Division
Dr. Patti L. TenBrook, Communities and Ecosystem Division

Scientists began the discussion by describing Region 9's definition of science as "applied technology." It can include information on toxicity or ways to measure exposures, including biomarkers, in communities living near Superfund sites. Sometimes the science is established (e.g., are exposures above or below a bright line) and sometimes the science is "undefined." In the latter case, regional scientists must define the question, create a hypothesis, develop a study approach, gather data and analyze it, and provide information to decision makers.

Scientists said that they "need to know our stuff" for all contaminants (even undefined contaminants). Regional scientists must know how to define toxicity and exposure, how to measure it, and how to manage it. For undefined contaminants, sometimes EPA scientists assume it is similar to another chemical that EPA has data for; sometimes if there are multiple contaminants, EPA assumes that cleaning up one will adequately clean up others; and some times EPA targets stringent cleanups for chemicals with known toxicity and assumes other chemicals will contribute only minor risks.

A scientist in the pesticide program spoke about the need for research on regional pesticide issues. The national model for some urban pesticides doesn't work for Region 9. Pesticides show up in waters; models and science need to be adjusted; and pesticide labels need to say something different. It is difficult for data generated in the region to have an impact on

reregistration evaluation of pesticides. Another scientist agreed that water bodies are designated as impaired under section 303(d) of the Clean Water Act because of pesticides. She called for a more transparent process for the science used in Total Maximum Daily Loads (TMDLs). Regions need tools for analysis at the watershed level to specify best management practices so they can be confident about TMDL numbers in contentious discussions.

Another scientist identified a need for training in using social science data for enforcement targeting. In the case of lead-based paint, social science methods could be used to identify vulnerable communities and help implement environmental justice policies. Another scientist compared Superfund's "exquisite tools to examine contaminant concentrations" with the lack of tools to respond to communities' concerns about social stressors that enhance their environmental risks. They noted that Superfund and RCRA do not have explicit language regarding environmental justice, a priority of Administrator Jackson, and many managers are reluctant to bring in factors to supplement risk assessments for fear that the resulting permit would be vulnerable to appeal. A scientist noted that the region typically conducts analyses of social issues only in dealing with tribes. Yet another scientist noted that the air division tries to target air monitoring on environmental justice communities. She also observed that the climate change program may also use vulnerability analyses and may lead EPA in new areas of social research.

A scientist spoke about the need for enhanced communication of scientific information - not just about risk assessments and their conservative assumptions, but also about benefit-cost analysis. He spoke of the need to communicate benefits more effectively in ways people can understand.

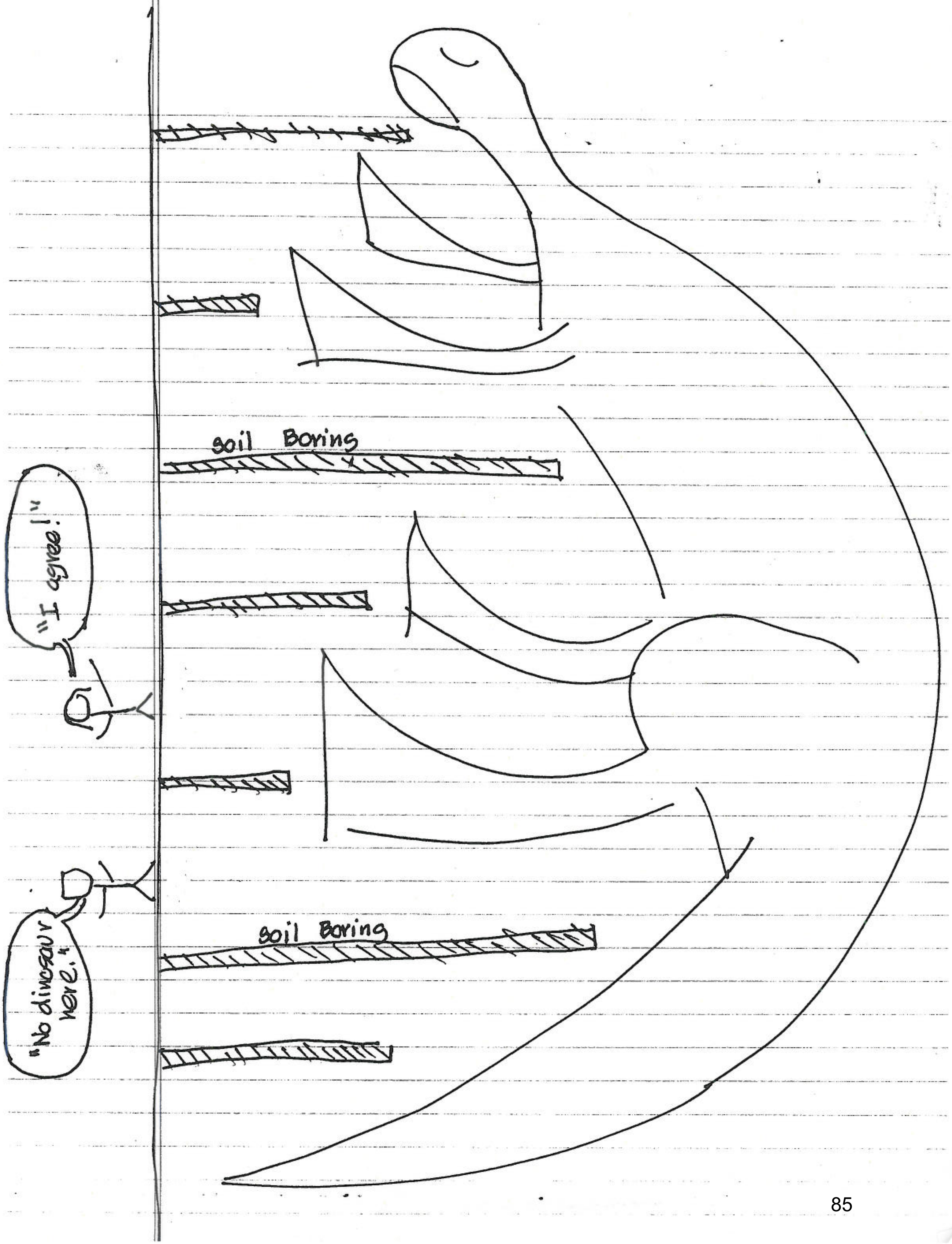
Scientists spoke briefly about EPA's lack of progress on cumulative risk approaches. Although EPA conducted two workshops on cumulative risk, the Risk Assessment Forum has not generated a document. One scientist recommended that the Science Policy Council should take the lead on cumulative risk.

Scientists then talked briefly about the overall state of EPA's science. One interviewee noted that EPA science is not academic science. It is driven by statute and precedent and sometimes "flies in the face of the general scientific community." In many cases, statutes must change for EPA to conduct and use "state of the art" science. Participants spoke of their awareness of the recent National Academy of Science "Silver Book," but complained that EPA has no integrated mechanism to respond to its recommendations. The Science Policy Council might be the appropriate organization to respond, but scientists viewed it as unlikely to respond. A scientist observed that EPA typically does not do "problem formulation" before it begins research. Another participant spoke of the difficulty factoring qualitative concerns identified in a problem formulation conducted to address tribal concerns about out gassing from a thermal oxidation unit into a quantitative analysis of air modeling. Other participants spoke of their frustration with EPA chemical hazard assessments, such as trichloroethylene, that lag behind published literature and Agency guidance. They spoke of the chilling effect of management decisions made with the expectation that science would be "ginned up" to support decisions already made.

Some scientists then spoke of new directions for Agency science, such as a new rule disclosing pesticide inert ingredients; a new public process for new pesticides; analyses of pesticides volatilizing off fields; and new studies focused on the children of farm workers. These new changes are happening quickly. They reflect a new political will and suggest that legal barriers to the use of science may be fewer than many assume.

SAB members asked scientists to conclude the discussion with their "wish list" for science integration. Individual participants responded with the following thoughts:

- Pesticide monitoring to validate predictions made during assessment and modeling.
    - Two scientists spoke about their proposal for a modeling and monitoring study of multiple stressors, including pesticides, and impacts on land use, water, and air.
- More support from ORD (especially more than the limited RARE funds, $200,000 per region per year) and better ways to interact with them.
    - ORD scientists' performance standards require 25-50% of each scientist's time involve work with regions.
    - More support like the ORD laboratory in Ada, Oklahoma for modeling.
- Need for regional statistician.
- Economists to help communicate environmental benefits and environmental justice concerns.
- More science supporting controls for underground injection of carbon dioxide.
- Better data management, better data sharing among EPA programs, and improved data quality.


soil Boring
soil Boring
"I agree!"
"No dinosaur here."

EPA Region 10 Science Integration for Decision Making Fact-Finding Interviews
December 8, 2009
1200 6th Avenue, Seattle, Washington

Five members of the SAB Committee on Science Integration for Decision Making conducted six interviews in EPA Region 10: Drs. Rogene Henderson, Wayne Landis, and Thomas Theis conducted the interviews in person and Drs. Penelope Fenner-Crisp and John Giesy participated by phone. For each interview, Dr. Vanessa Vu, Director of the SAB Staff Office, provided a brief introduction to the purpose of the interview and the Designated Federal Officer, Dr. Angela Nugent, took notes to develop a summary of the conversation. All interviewees were provided a copy of the committee's Preliminary Study Plan in advance.

Dr. Vu noted in each interview that the purpose of the interview was to help SAB Committee members learn about Region 10's current and recent experience with science integration supporting EPA decision making so that the SAB can develop advice to support and/or strengthen Agency science integration efforts. Dr. Vu thanked participants for taking time for the interviews and thanked Dr. Roseanne Lorenzana for serving as liaison with the SAB Staff Office in planning the interviews and Mr. Don Martin for serving as facilitator.

EPA Region 10 Scientist Participants (8:30-9:30 a.m. Session)

Mr. Don Martin, facilitator, ecologist , Office of Water and Watershed, Coeur d'Alene office
Ms. Allison Hiltner, Superfund Remedial Project Manager, Office of Environmental Cleanup
Mr. Bruce Duncan, ecological risk assessment, Office of Environmental Assessment
Dr. Dana Davoli, human health risk assessment, Office of Environmental Assessment
Ms. Denise Baker-Kircher, remedial project manager, Office of Environmental Cleanup
Mr. Larry Gadbois, Hanford project manager, Office of Environmental Cleanup
Ms. Sheila M. Eckman, Unit Manager, Office of Environmental Cleanup

SAB members began the discussion by asking Region 10 staff to identify their principal customers. One scientist working on Superfund issues identified the Department of Energy facility owner at Hanford as his principal customer because that organization must implement EPA's decisions. Interested stakeholders are the other major customer. Other scientists working on Superfund issues responded that EPA decision makers, specifically Superfund program managers, are the principal customers. Still others viewed the question more broadly; the "bugs and bunnies" and everyone affected by the contamination EPA is addressing are customers. In EPA's dredging program, which addresses disposal of dredged materials, the ports and entities responsible for dredging are major customers.

In response to an SAB question, scientists commented on collaboration with science partners in Canada. EPA scientists have collaborated on risk assessments and sit on technical workgroups on problems of interest to the Region and Canada. Some regional experts focus on transboundary issues.

Interviewees discussed the nature of policy and science interactions in the region. One interviewee noted that each site remediation project and each Project Manager is unique. Project managers can approach sites "how they wish, within frameworks and guidelines." There is no cookie-cutter approach to science integration. As a general rule, however, good interaction requires repeated, ongoing interactions between scientists and project managers.

Effective integration of science depends, in part, on the level of controversy associated with decisions. Science has been effectively integrated in dredging decisions where a decision has had a limited effect or is perceived as having limited effects. In contrast, work in Puget Sound on dioxins and furans sparked a debate over risk across the scientific community, within affected agencies, and in the regulated community. The policy debate overshadowed effective discussion of the science issues. When an outcome is potentially costly, science integration supporting policy can be difficult.

From one scientist's perspective, Region 10 integrates new science into decisions fairly effectively. Scientists can facilitate this process by getting involved early at the problem formulation stage, discussing risk assessment and risk management options from the start of a project.

Region 10 is unique because it interacts with more tribes than any other region (over 250 tribes) and tribal work underscores that all tribes are different. Tribes hold different opinions about how EPA should conduct risk assessments and take their culture into account. As a result, Region 10 scientists look at exposure routes (e.g., fish consumption) and ecological values that others regions don't address. The region often must address situations where tribes criticize EPA for not cleaning up sites to the extent the Tribes desire.

SAB members asked interviewees to comment on the source of the science used by the region. Scientists responded that the region has some "really good people who do science but not a lot of them." Regional scientists are primarily conduits for scientific information. They identify scientists outside the region who can provide needed information and "scrape up people who can oversee that science." Many interviewees agreed that "we're doing a lot of work without a lot of people" and voiced concern that the region will not have enough people and time to oversee all the science generated outside EPA.

ORD only provides limited science support for the region. Because ORD does not have enough scientists to devote to all the Superfund projects, Region 10 scientists reach out to other organizations. They often use science generated by the Army Corps of Engineers.

To maximize consistency in the use of science across sites, where Region 10 "can't be involved in ground-level analysis," regional scientists look for consistency in application of Superfund risk assessment guidelines and frameworks. Scientists appreciate consistency in toxicity data and use the Integrated Risk Information System (IRIS) database and other kinds of toxicity provided by ORD and program offices, following the hierarchy of data sources established by the Office of Solid Waste and Emergency Response. Regional scientists focus their attention on exposure analysis, reviewing, in many cases, exposure data provided by responsible parties. Regional scientists primarily focus on assuring a good sample design,

reviewing data, reviewing preliminary evaluations, and making decisions to acquire additional data. Integration of the final exposure information with hazard information and other needed science input for decisions, by contrast, is relatively easy.

For exposure analysis, the Superfund scientists use environmental fate and transport models appropriate for a specific site. Sometimes models are EPA models; sometimes models are available in the open literature; and sometimes they are run by contractors working for the Potentially Responsible Parties. Interviewees were not familiar with the modeling database managed by the Council for Regulatory Environmental Models.

The discussion then turned to uncertainty characterization in the science supporting clean-up decisions. EPA scientists must provide scientific information that "fits into a decision framework" and that focuses on effective decision making. Although EPA policy requires identification of a no observed effects level and lowest observable adverse effect level, scientists generally expect a clean-up value to lie between the no observable effect level and the lowest observable adverse effect level. Where there are uncertainties associated with detection levels, assessments should describe the key uncertainties. Sometimes EPA may be able to address uncertainties through monitoring requirements. At other times, addressing uncertainties will have to wait until science or policy evolves.

Although scientists acknowledged limitations in EPA's IRIS toxicity values, they welcomed a policy that required regions to use those values, where available. Without those values, EPA regional scientists would face contentious issues over hazards, as well as challenges over exposure assessments particular to each clean-up site. EPA would face issues of fairness and consistency across sites. The Region does, however, consider special circumstances that would make use of IRIS values inappropriate. One example is exposure to PCBs and dioxin through mother's milk. Because IRIS does not contain short-term toxicity values, Region 10 used Minimal Risk Level values generated by the Agency for Toxic Substances and Disease Registry.

Two scientists commented on the potential use of biomarkers for exposure assessments. As a practical matter, they noted problems in identifying populations for biomarkers and problems interpreting biomarker data. The current state of the practice is to identify biomarkers linked to another endpoint routinely used for regulation, but few precedents exist. EPA does not have established policy on biomarkers. The National Oceanic and Atmospheric Administration (NOAA) advocates use of biomarkers, but EPA resists. EPA is not looking for the lowest possible response from an organism; EPA is not prepared to deal with that kind of information and instead seeks information that can be used as a basis for regulatory decisions.

SAB members asked scientists to comment on how they receive feedback on the science supporting Agency decisions, especially since much of the information is generated outside EPA. Interviewees responded that "lots of people are watching us" and providing feedback. Tribes, states, potentially responsible parties, technical advisory groups, communities, and other federal agencies provide feedback. EPA tries to provide open, transparent science. Scientists and non-scientists outside EPA question the science underlying EPA's decisions and EPA considers this feedback.

The session concluded with a discussion of impediments to the effective integration of science to support decision making. Scientists called for more resources to plan and conduct the science needed to support decision making. One scientist called for more internal checks on external science. Another scientist noted needs for improved hardware and software. In some cases, project managers are not equipped to run models developed by Potentially Responsible Parties.

Interviewees were asked to consider whether the region had a need for a more systematic approach to stakeholder interaction. One scientist responded that she makes a strong effort to bring tribes into human health risk assessment on tribal lands or on their usual and accustomed hunting and fishing areas. She involves tribes throughout the technical analysis and takes advantage of available funds for this purpose. Tribes sometimes challenge EPA to address cumulative risk and integrate tribal culture into EPA decisions. EPA does not have policy and guidance for this purpose and EPA staff "don't know how" to address these often-expressed needs.

Other interviewees acknowledged that EPA does not have a systematic framework for interacting with communities, but Region 10 tries to be transparent and scientists are experimenting with different models. For the Duwamish project, the project manager is sharing every draft of science assessments with a wide audience. Because "people see things really early…and some drafts are in process and not worth reviewing," she did not recommend this approach for all projects. Superfund has very limited requirements for public involvement. An interviewee noted that public involvement often strengthens Agency science because it helps raise important questions. Sometimes, however, the public has difficulty distinguishing between science and policy. EPA needs to "be vigilant" and keep science and policy distinct.

EPA Region 10 Scientist Participants (9:45-10:45 a.m. Session)

Mr. Don Martin, facilitator, ecologist , Office of Water and Watershed, Coeur d'Alene office
Mr. Ben Cope, modeling/environmental engineer, Office of Environmental Assessment
Mr. Brian Nickel. Engineer-in-Training, water quality permit writer, Office of Water and Watersheds
Ms. Carla Fisher, Corrective Action Project Manager/Permit Writer, Office of Air, Waste and Toxics
Mr. David Bray, Special Assistant to the Director, Office of Air, Waste and Toxics
Mr. David C. Croxton, Watershed Unit Manager, Office of Water and Watersheds
Ms. Gretchen Hayslip, aquatic biologist/water quality monitoring, Office of Environmental Assessment
Ms. Lisa Olson, National Pollutant Discharge Elimination System (NPDES)permit writer, Washington NPDES Oversight Coordinator, Office of Water and Watersheds
Ms. Lynne McWhorter, Environmental Impact Statement review, Office of Ecosystems, Tribal and Public Affairs,
Mr. Michael J. Szerlog, supervisory scientist, Office of Ecosystems, Tribal and Public Affairs

Regional scientists began the discussion by describing the kinds of decisions they are involved in and the sources of science input for those decisions. A water quality permit writer described her job as determining the amount of pollutant allowed to be discharged. The science she needs comes from the regulated entity, states, and tribes. She uses EPA's in-stream water quality criteria and narrative criteria for chemicals for which there are no formal quantitative water quality criteria. EPA generally receives stakeholder input when permits are offered for public comment. Stakeholder comment, especially comment from tribes and other who know waterbodies and fisheries well, can be quite helpful to EPA. If a permit is particularly complex, EPA might seek comment "up front" from interested parties. The National Marine Fisheries Service and Fish and Wildlife Service typically provide input, when there are Endangered Species Act concerns. In general, scientists agreed that EPA makes water quality decisions based on site-specific science primarily created by others and then monitors to check that requirements are met.

In the context of the waste program, project managers rely on the Region's Office of Environmental Assessment. Project managers also have ongoing discussions with the facility and the state and/or tribes and review risk assessments developed by the regulated facility. EPA takes public comment on proposed decisions and comments are often received on the science involved in a decision. There is no formal external peer review of site-specific science. The Region 10 peer review process sometimes includes the site-specific science, but it's not an external-EPA process.

For Environmental Impact Statements, regional scientists review predictions and analyses developed by other federal agencies. In cases where reviews involve highly technical issues, such as mining analyses, EPA sometimes contracts out the review.

A representative of the Region's Office of Environmental Assessment described how his office assists decision makers when an issue is complicated or controversial. His office builds water quality models to support major projects, as in the Snake or Klamath rivers. These water quality models receive independent peer review and funds are set aside for this purpose. Modeling experts often provide comment as part of the public comment process. He noted that he had not used the clearinghouse provided by EPA's Council on Regulatory Environmental Models (CREM). In general, the modeling community "gravitates" towards a few well accepted, well maintained models appropriate for application to particular water bodies. He has suggested that these models be added to the CREM list.

A regional scientist described the wide range of decisions made by the region's air program, which is drawn into decisions at the local, regional, and global scale. Many decisions have a scientific underpinning and involve analyses to predict the results of potential action on air pollution. The program principally uses "canned programs," i.e., established models and tools described in the Code of Federal Regulations. A key science issue involves the underlying data to be used in models. One current challenge involves a decision about permitting multiple exploratory drilling operations north of the Arctic Circle. EPA has no air quality models for over water north of the Arctic Circle and no meteorological data for the area in question. The decision to be made involves short-term deadlines, huge financial implications, a high level of community interest, with technical experts on every side. Although the air program is known as

a "data rich program," in this case, monitors are not in place where they are needed and decision makers are "torqued around the axle trying to make decisions with almost no science to deal with." The region would like to ask the regulated entity to provide more science, but the permittee "wants a permit as soon as they can with the lowest cost."

Other interviewees also discussed impediments to using the best science available. One engineer noted that the water quality program relies on available numeric criteria, but many criteria are over twenty years old and some are out of date. EPA is vulnerable to challenge where there are no quantitative criteria and EPA must interpret a narrative criterion (e.g., "no toxics in toxic amounts"). Another interviewee noted that self monitoring requires relying on the regulated entity to conduct water samples and interpret results. Some states have accreditation problems and some small dischargers, such as treatment plan operators may not be prepared or equipped to conduct sampling adequately.

Other interviewees noted that it would be helpful to improve public and stakeholder perception of scientific uncertainties. Another interviewee emphasized the importance of planning. If EPA were able to "get ahead of the curve and engage early enough to conscientiously design and conduct needed monitoring" to anticipate new permits, EPA could use that science for decision making and be better able to handle controversial issues. An interviewee also noted the importance of separating policy from science issues and communicating clearly the difference to the public.

In terms of resources, an interviewee noted the region's need for a geochemist and additional modelers. She also noted the particular time pressures of the NEPA program, which gives EPA 45 days to review an Environmental Impact Statement. With limited staff resources, she found it difficult to recognize science gaps in complex and varied statements.

Despite the barriers, interviewees communicated that "what's important is that we do the best science we can." In the case of the Arctic Circle air permit, for example, where needed data is missing, regional scientists are providing conservatives estimates of the worst-case scenario. This analysis, which will likely impact permits for drilling, will constrain oil companies, and may motivate them to collect the needed empirical data.

The discussion concluded with a brief exchange on workforce issues. Interviewees noted that Region 10 generally supported training needs, but that there is a real need for regional scientists to get more advanced degrees. They expressed concern about increased "contracting out" regional science. There have been few recent hires, but when there is an opening, the regional carefully considers the expertise needed. In response to a question about social science, interviewees responded that the region would not generally expand into this area without an initiative and a "good regulatory framework" from Washington. Participants noted that many environmental decisions are made by states, which have "less science support than we do." Interviewees noted that interaction with universities in the region is generally *ad hoc*. The region generally interacts with local universities only if they already have research underway on a common problem.

Interviewees noted that their interactions with ORD are limited. The RCRA program, for example, does not have "a lot of money for ORD support" and generally gets more active support from the Corps of Engineers. The Superfund program benefits from a large budget supporting ORD scientists. Interviewees expressed frustration that ORD has focused in general on longer-term research and not on "real-world" development needs of the regions. Interviewees were not aware of ORD's Science to Achieve Results program or its grantees in the region.

Discussion with the Regional Economist, Mr. Elliott Rosenberg (11:00 - 11:20 a.m.)

In the brief discussion the regional economist noted that only Regions 5 and 10 had economists. In Region 10, he pursues two kinds of activities: financial analyses for enforcement and compliance decisions and economic analyses, primarily for NEPA reviews. He is currently developing BART guidance (Best Available Remediation Technology), in consultation with economists in OAR's Office of Air Quality Planning and Standards, to determine whether use of BART will interfere with a firm's viability.

He noted that it is difficult to be the sole economist in Region 10, because the region does not typically think to include him when economic issues arise since the focus is primarily on environmental science. He takes the initiative to pursue environmental economics issues in collaboration with other federal agencies, especially the Fish and Wildlife Service, U.S. Geological Service, and National Oceanic and Atmospheric Administration, which has a program that involves environmental economists and human dimension scientists in decisions. EPA has a different culture, almost a sense that "economics will spoil our good science." He noted that although "lot of economics isn't prescribed by policy at the regional level," good environmental management involves social science.

He noted that it would be valuable to integrate concepts of ecosystem services into the work of the region and involve social sciences and decision sciences into regional efforts in the Willamette Valley and Puget Sound.

EPA Region 10 Scientist Participants (12:45-1:45 pm Session)

Mr. Don Martin, facilitator, ecologist , Office of Water and Watershed, Coeur d'Alene office
Mr. John Palmer, Office of Water and Watershed
Mr. Bernie Zavala, Hydrogeologist, Office of Environmental Assessment
Ms. Carla Fromm, water quality, Idaho Operations Office
Ms. Erika Hoffman, Office of Ecosystems, Tribal and Public Affairs
Mr. Greg Kellogg, Alaska Operations Office
Mr. Leigh Woodruff, Idaho Operations Office
Dr. Tracie Nadeau, environmental scientist, Washington Operations Office, Office of Ecosystems, Tribal and Public Affairs

SAB members began the discussion by asking participants to describe what they do and where they get their science. A scientist working in the Superfund program described how the science he used was "home grown." For the sites he works on, he characterizes ground water flows, conducts an investigation, and presents managers with a conceptual site model of where

groundwater is flowing. He has developed relationships with ORD scientists in Ada, Oklahoma and Las Vegas and "reaches out to them" when he needs help. He also draws on a network of peer scientists working on Superfund issues through a national workgroup. He participates in EPA's Groundwater Forum, which includes hydrogeologists from all 10 regions, who meet together twice a year. In addition, he interacts with technical staff in EPA's Office of Water.

Another scientist described her work in an Operations Office. For National Pollutant Discharge Elimination System (NPDES) permits and for Environmental Impact Assessment reviews, she works with the Office of Environmental Impact Assessment. A current assessment involves impacts on endangered snails in the Snake River. For that review, the region conducted a literature survey of possible impacts. There is a limited data set and limited resources for the scientific review of a complex issue (i.e., the New Zealand mud snail is also pushing the endangered snail from its habitat). She voiced concern for the limited review possible for the region and acknowledged that the region was not equipped to conduct a cumulative ecological assessment.

Other scientists discussed reliance on science provided by permittees. One described working with the aquaculture industry, for example, to help identify limits for phosphorus.

An interviewee described how science issues can change in response to new legal interpretations. He described how a recent Supreme Court Decision had changed requirements for data showing a link to waters of the United States before Clean Water Act requirements apply. As a result, enforcement cases involve collection of large amounts of data to establish the jurisdiction of the Clean Water Act before case development. Regional scientists would prefer to focus time and resources on hydrology and vegetation impacts and lost ecosystem services.

One scientist in the water program discussed how the region needed information on mercury at several different scales to determine water quality impairments for writing permits. Local information on mercury levels in fish and water is needed. The region also needs science at a global level to understand mercury deposition originating from Asia and Europe. EPA must understand global mercury issues so that it doesn't "make the wrong decisions about regulating local emissions." For this issue, regional scientists get information from program offices, from the U.S. Geological Service, the "premier science agency working on mercury," and from the international scientific community. A representative from Region 10 attends international biennial scientific conferences on mercury,

Another scientist described working with EPA's Office of Water on approval of state water quality standards and NPDES permits. These permits generally involve scientific analysis of effects on endangered species and consultations on section 7 of the Endangered Species Act. Typically, there is never enough information to make decisions with confidence about endangered species. There are different sources of scientific analyses: Region 10's Office of Environmental Assessment, the Office of Water, the Fish and Wildlife Service, and NOAA. The Endangered Species Act and Clean Water Act deal with risk differently; EPA scientists look for consensus, where possible. They have sought areas of agreement and have tried to codify them, providing a useful, common source of knowledge. On example is guidance developed with affected states and the Fish and Wildlife Service that codified knowledge about temperature

and salmon. In contrast, one area of major differences is metal impacts on fish. There is a wide range of science perspectives. Regional scientists focus on what can be done, despite the differences, to minimize impacts on the environment. Working with management, they try to negotiate an action that everyone can live with. In general, the Endangered Species Act requires that EPA focus more sharply on specific endpoints than water quality standards that more generally protect a designated use.

A regional scientist spoke of efforts to characterize uncertainties in developing water quality standards for toxics. He noted that when EPA develops a quantitative risk assessment, it is most comfortable protecting the median, more comfortable with central tendencies, rather than protecting one end of the spectrum.

A scientist offered a three-party typology for thinking about regional science. For the first category, she noted that analysts must consider the scale of questions being asked, i.e., whether they are for specific sites or whether they are national in scope. For low-profile Superfund sites, there is generally ample time and money to develop the science needed. For the second category, national decisions, there may also be time to develop the science needed. For the third category, site-specific decisions where EPA does not have the resources and times it might have for a Superfund site, EPA may use first principles, but people generally want site-specific information.

The interviewees then discussed their interactions with ORD and the use of ORD science for Region 10 decisions. An air program scientist spoke of the lack of funding in ORD for mercury research, which was, she said, a "serious problem for us." Region 10 has sought to undertake research on mercury methylation, but hasn't found a partner or funding through ORD for this potentially valuable research.

Another scientist spoke of her own "incredibly productive collaboration" with ORD's Corvallis laboratory over many years. She acknowledged, however, that it is difficult to get support or collaboration from ORD if regional needs are not included in ORD's five-year plan. In addition, ORD rewards its scientists for academic publications, not regional support. She noted that regions and programs must work diligently to explain the context for needed science; that effort can make productive collaborations possible. The difficulties involved in collaboration underscore the need for more scientists in region and program offices.

Another interviewee noted the cumbersome nature of ORD's multi-year planning process. He investigated significant time and effort in cross-regional efforts to communicate regional research needs for ground water programs. The process is beginning to show results, but the effort "moved very slowly."

Other scientists emphasized that the region needs to build relationships beyond EPA and to seek research support other than from ORD. She recommended that regional scientists should reach out to the Forest Service and other agencies, because other organizations have larger research budgets. It takes time, however, to build effective collaborations and individual regional staff may lack the time and resources to do so.

Participants then spoke about human resource needs for regional scientists. One interviewee spoke of difficulties planning for future science training, since programs can be whip-sawed by politics or Supreme Court decisions that can change the science needs for a program. Another scientist noted that technical staff stay abreast of developing science and "keep themselves aware and flexible based on their own individual personality." Another participant stated that he relies on information exchanged in EPA's national workgroups and that there were very limited training funds.

Several scientists observed that the region has "valued having in-house scientific expertise less and less." The region increasingly hires generalists. It increasingly has fewer program and national experts; lack of storm water expertise is an example. The region has increasingly contracted out science activities. Another scientist commented that time pressures prevent scientists from reading the latest journal articles, knowing who to contact for technical information, and even arranging for contract support.

EPA Executive Team Participants (2:00 - 3:30 p.m. Session)

Mr. Tim Hamlin, Associate Regional Administrator
Ms. Christine Psyk, Associate Director Office of Water & Watersheds
Mr. Richard (Rick) Albright, Director, Office of Air, Waste & Toxics
Ms. Ann Williamson, Associate Director, Office of Environmental Assessment
Ms. Lori Cohen, Acting Director, Office of Environmental Cleanup
Mr. Anthony (Tony) Barber, Director, EPA Oregon Operations Office (by phone)
Mr. Rick Parkin, Acting Director, Office of Ecosystems, Tribal and Public Affairs
Ms. Lauris Davies, Associate Director, Office of Compliance and Enforcement
Ms. Ann Prezyna, Deputy Regional Counsel, Office of Regional Counsel
Ms. Marcia Combes, Director EPA Alaska Operations Office

The executive managers began by discussing how they make decisions and incorporate science. One manager noted that the Office of Environmental Assessment challenges programs to ask permittees for information needed for decisions. Decision makers need to manage information flowing from multiple sources, both inside and outside the regional office.

Another executive manager spoke of how science permeates everything the region does. In the case of a permit being reviewed for the North Slope, a permittee assembled data but lacked good meteorological data, which makes the permitting process much more challenging. The permit applicant modeled air quality impacts of the project, and a scientist in the region's Office of Environmental Assessment conducted an independent analysis as a check and ran different scenarios. Permit engineers review the permit application and prepare the permit and supporting documentation. Chemists in Region 10's Office of Environmental Assessment conduct quality assurance reviews of the applicant's sampling plan and negotiate needed revisions.

An executive manager in the Superfund program discussed how science underlies clean-up decisions. The region identifies key human health threats. The regional laboratory analyzes chemical warfare agents and works on advanced analytical methods. Superfund actions require consideration of risk and exposure pathways, long and short-term impacts within the framework of the nine Superfund criteria. Key questions are: what does science show about impacts and

what would be protective? The Superfund program requires a five-year follow-up on remedial actions, which necessitates evaluation of any new information.

An executive manager in the water program noted limited authority and funds for EPA to generate data for permits. Instead, permitees provide EPA with data and information to support permit decisions. She noted that EPA has guidance that helps regional staff evaluate the quality of science received from permittees. Guidance for Quality Assurance and Quality Control as well as peer review of reports and analyses help guarantee the quality of science. One obstacle was that sometimes the same data can be interpreted quite differently by different scientists. If there is great uncertainty, because data is limited, EPA tries to be conservative in its interpretation. "If there's more information, we could provide more flexibility." If a regulated entity understands that providing more information may provide them with more flexibility, they may provide additional information to build a more complete scientific picture of environmental impacts.

Executive managers spoke of the challenge in making decisions under uncertainty. For some "sticky issues," (e.g., PCBs, dioxins, and furans), EPA never has adequate science information to satisfy all parties, and must make decisions in the face of uncertainty. The region uses its limited internal resources "to cut down uncertainty," but a executive manager noted that the region is losing expertise and "actually are in dangerous situation." He noted that EPA used to do water and air monitoring, but that regional resources for ambient monitoring have been almost eliminated. Experts are retiring and some current reviewers don't have the needed level of experience. It is dangerous because EPA sometimes makes regulatory decisions on science provided from outside the region, without a basis for evaluation.

An SAB member asked whether regional managers had received training in making decisions in the face of uncertainty to promote more consistent decision making. Executive managers responded that they had not taken specific courses in that subject area. Many executive managers, however, have engineering training. Executive managers learn through the course of their career to use judgment to make good decisions. Decision makers must use judgment in the context of political pressure, drawing on support systems within the agency. Decision makers have different modes for building support for decisions. One manager related the example of regulating chlorine and dioxin discharge from paper mills. This was a difficult decision for Region 10 and required advance work with program offices to build consensus and support. Region 10 was the only region to issue a TMDL for dioxins and furans. Other regions addressed the issue facility-by-facility. EPA was not consistent across the nation, but Region 10 had strong support for its approach.

An executive manager observed that one set of unknowns involves the level of toxic substances in the ambient background. She asked how decision science would help, when EPA is not sure about the level of dioxin or lead in the background.

The executive managers discussed cumulative risk assessment as the "next big challenge." EPA does not have tools to conduct cumulative risk assessments. Superfund risk assessments focus on single contaminants. EPA does not address the total set of risks (e.g., food sources, multi-media sources at a site, and other life stresses) that may be of interest to a

community. One manager noted that Region 10 does consider whether a number of similar projects in an area are ongoing or proposed. It does consider whether a single permit should be looked at within the context of other particular projects in line to be permitted.

Another member observed that EPA scientists do indeed have tools for assessing cumulative risks, but EPA is not equipped to deal with the results. Region 10 risk assessors have looked at cumulative risk from various contaminants, life impacts, and multiple exposure, but the Superfund process is not designed to deal with these multiple analyses for cumulative risk.

The executive managers addressed planning for future human resource needs for regional scientists. One manager responded that Region 10 does succession planning. The region anticipates likely future retirements for key positions. For example, for a retiring, world-class water-quality modeler, the region filled behind him and allowed the new person to "team with him" to learn on the job. That kind of hiring is desirable, but not always possible.

The region has a small number of new positions to fill every year and considers each hire carefully in light of unmet needs across the region. Regional managers have also shifted personnel into new lines of work, although retraining individuals depends on the personality of the individual. The executive managers noted success in hiring qualified, civic-minded people in recent years.

The executive managers discussed innovative strategies to stimulate their workforce. They partner with the private sector, reach out to other federal agencies, and interact with universities.

An SAB member asked about how regions provide stakeholders with opportunities for input in science processes early in projects. Managers described several approaches. A dredging project in Puget Sound involving dioxin, for example, has a very active process for engaging stakeholders. There were six or seven meetings and technical workgroups before developing a framework and early dissemination of a draft framework, followed by multiple meetings. In this case, stakeholders have interpreted data differently from each other and EPA. It was frustrating because "advanced stakeholder input (is) giving ammunition to resist us."

Region 10 had a different experience in Oregon, where a stakeholder group voiced concern over a low fish consumption rate being used to determine a water quality standard. The stakeholder group was very sophisticated and worked with states and tribes, so that the state of Oregon adopted a higher fish consumption rate that would protect the tribes. Effectiveness of stakeholder processes depends on the knowledge and ability of the stakeholder to "stay at the table" and understand the legal process.

In the air program, EPA faces challenges from oil and gas companies seeking permits and native communities who are likely to fight permits affecting off-shore resources.

A manager capped off the conversation by reflecting that the region is driven to use science by the questions it has to answer, and not by the pursuit of knowledge in the holistic sense. The Region is focused on solving present issues, and not preventing future issues or

planning for how to address them. As a result, for example, the region does not develop or use science to address pharmaceuticals, flame retardants, or personal care products for which EPA has no guidance. He noted that science helps the region "answer questions others ask of us; it does not help us frame questions or actions to take." Other managers agreed that the region used science to solve problems and did not conduct research per se.

The meeting concluded with a discussion of two other topics: traditional environmental knowledge and economics. The executive managers noted that tribes ask the region to integrate tribal knowledge in decision making. In the NEPA and air programs, managers treat comments about tribal knowledge as one kind of stakeholder input that often influences the options chosen. A manager described Region 10's tribal council, which meets two times per year. It is difficult to factor traditional knowledge into EPA's decision process and systematically act on it. Managers talked about the possibility of drawing on anthropologists expert in indigenous knowledge systems. A manager noted that the Office of Pesticide Programs has developed the Tribal Lifeline Model that factors traditional and western knowledge together.

The executive managers briefly discussed the role of economics and economists in the regional programs. One manager noted that economics is important in decisions on regional haze decisions pertaining to best available retrofit technology and affordability. These analyses are complex and require attention from the regional economist, or two senior environmental employees, or a contractor. Other managers agreed that analyses of ability to pay are important for enforcement decisions. Cost can also be considered in the Wetlands 404 program, which calls for a determination of the least environmentally damaging practical solution. Cost can be considered.

Meeting with the Acting Regional Administrator (Ms. Michelle Pirzadeh) and Acting Deputy Regional Administrator (Mr. Daniel Opalski) (4:00 - 4:30 p.m)

The Acting Regional Administrator and Deputy were asked to assess the use of science in Region 10. The Acting Regional Administrator responded that different programs would provide different answers. Region 10 has recently tried to enhance the profile of science in the region through the regional science steering committee, chaired by the directors of the Office of Environmental Assessment and Alaska Operations Office. Region 10 is also in the process of completing accreditations of the regional laboratory.

The region is also trying to introduce new practices to highlight the importance of science. Decision makers now hear directly from science experts in the region before making a Superfund clean-up decision. The change ensures that information for decision makers is not funneled through the remedial project manager. The decision maker can also share how science is being used in deliberations, something important for interdisciplinary teams to understand.

Public comment plays an important role in Region 10. So many issues attract a diverse set of interested parties that "energetic debate" plays an important role when time doesn't allow for peer review. People come to public forums and expect to be listened to. There are 271 federally recognized tribes and native Alaskan villages. Some have sophisticated capabilities, as well as a well as dedication to communicating native knowledge.

In regard to relationships with ORD, the expectation is that staff have strong relationships with ORD and make the most of them. The Regional Administrator's office does not have executive-level interactions or briefings with ORD. The Acting Regional Administrator noted past efforts by the lead region for ORD to strengthen real-time support from ORD. She expressed interest in follow up on that effort.

When asked to comment on impediments to using science for decision making, the Acting Deputy Regional Administrator described the pending decision on permits for the outer continental shelf. The stakes are high, and EPA's mandate is to use data to protect National Ambient Air Quality Standards based on science. EPA lacks background ambient air monitoring data for drilling 60 miles off shore. Existing ambient monitoring data is not representative. The permittee is characterizing EPA is overly conservative in its proposed permit condition, which require the applicant to submit representative monitoring data or impose costly controls. Without scientific data, decision making is difficult and raises questions about EPA's credibility.

The acting RA and acting DRA spoke of the difficulties in making decisions, when EPA has disinvested in monitoring. It is easy to reduce monitoring because the benefits are in the future. But many decisions are impaired because needed monitoring that's accessible and integrated doesn't exist.

In terms of human resources, the region recently created supervisory positions for interdisciplinary scientists. This change represents a culture change for Region 10. It will be useful for scientists to have managers who have technical training. The leadership team noted that Region 10 has conducted some succession planning and planning for diversity, but need to reserve more time to think ahead to those issues. Regional managers are seeking cross-training for employees. They are looking for creative ways to support core programs and reinvest in the technical base supporting core functions.

The leadership team (executive managers) noted that they cannot staff all expertises needed to address emerging issues. The Acting Regional Administration expressed the wish that "we could rely on centralized expertise in ORD where we need it, when we need it." In her view, that would be better than building capability in every region.

SAB members asked about regional use of social science, risk communications, economics, stakeholder involvement, behavioral science, decision science, and science to understand tribal relations. The Acting Regional Administrator noted that stakeholder involvement and decision making was a focus in Region 10. The SAB members had not met directly with staff focused on these functions. Region 10 also has tribal coordinators who focus on the cultural of regional interactions with tribes. The region has developed the North Slope Communication Protocol, which provides guidance on how to communicate science to native communities at the subsistence level and how to interact with them.

The Acting Deputy Regional Administrator acknowledged that the region does not have a lot of "credentialed focus" in the social science, but that it had "many hobby-level practitioners." These areas of expertise have not been formally considered in hiring decisions. He noted that his

past experience in Region 10 validated the importance of training in risk communication. Region 10 may not have credentialed experts, but it does have sensitivity to the issues of interest to the SAB. The Acting Regional Administrator noted that the region has engaged its regional economist in projects across the region and, because regional needs are different than when he was hired, is working on redefining needs for economic expertise. Region 10 also has used an Intergovernmental Personnel Agreement to place a tribal member in the Regional Administrator's Office as a senior tribal policy advisor. This individual advises on how best to work with Tribal Governments and has been very valuable.

EPA Office of Air and Radiation Office of Atmospheric Programs (OAP) Climate Control Division (CCD) Science Integration for Decision Making Fact-Finding Interviews
November 19, 2009
Washington, DC

Three members of the SAB Committee on Science Integration for Decision Making interviewed the CCD Staff: Drs. John Balbus and Thomas Wallsten in person and Dr. Catherine Kling by telephone. Following that meeting, the SAB committee members interviewed the CCD Director and Chief of the CCD Climate Science and Impacts Branch. For each interview, Dr. Angela Nugent, Designated Federal Office for the committee, provided a brief introduction to the purpose of the interview. She also took notes to develop a summary of the conversation. All interviewees were provided a copy of the committee's Preliminary Study Plan in advance.

Dr. Nugent noted in each interview that the purpose of the interview was to help SAB Committee members learn about OAP's current and recent experience with science integration supporting EPA decision making so that the SAB can develop advice to support and/or strengthen Agency science integration efforts. Dr. Nugent thanked participants for taking time for the interviews.

Interview with CCD Staff
Mr. Jason Samenow
Mr. Benjamin DeAngelo
Mr. Reid Harvey

Discussion focused on EPA's endangerment finding, since CCD has the lead on synthesizing the scientific information used in determining whether greenhouse gases endanger human health and the environment, a determination that would trigger EPA regulations of greenhouse gases. Staff described their role as a bridge between the outside scientific community and decision makers at EPA, other federal agencies, and Capitol Hill. They viewed their role as translators of climate science. Their goal is to be knowledgeable enough about science to know the issues and how they are evolving, and their relevance. They develop "policy-friendly" summaries of the science, often with the help of contractors. CCD's applied science work is conducted through contracts and cooperative agreements

In response to a question about scoping the nature of the climate change problem, staff agreed that the science supported and CCD proposed a broad scope, which was accepted by both Administrators Stephen Johnson and Lisa Jackson. The proposed finding states that climate change impacts human health, society, and the environment. Effects have a long time horizon, decades to 100 years. They relied on science assessments by the Intergovernmental Panel on Climate Change and the U.S. Climate Change Program. They conducted no new scientific analyses. A proposed endangerment finding was published in April 2009.

The technical document underlying the proposed endangerment finding (the Technical Support Document or TSD) received outside peer review, followed by review by EPA's Office of General Counsel, interagency review, and review by the Office of Management and Budget. They received over 380,000 individual comments, which include 10,000 to 11,000 unique

comments that EPA must address, and conducted two public hearings. Scientists from EPA's Office of Research and Development contributed significantly to the health and air quality chapters.

An SAB committee member asked CCD's plans to prepare the science for future decisions that would not be dichotomous and, instead, would involve decisions about safe levels of carbon dioxide. Staff acknowledged that regulatory analyses for greenhouse gas mitigation would raise benefit-cost issues, including how to communicate avoided risks that were very complex-- with a long time horizon, delayed effects, a range of climate sensitivities, and a range of assumptions about human behavior. Such risk issues require a high level of science integration.

A CCD staff member spoke of Congressional requests for analyses of different climate bills. EPA is presented with different assumptions as a basis for the requested analyses. Much of the focus is on costs. To assess benefits, EPA describes qualitative benefits, quantifies biophysical impacts related to ecosystem services, and is exploring methods to monetize benefits. One option is the social costs of carbon, where EPA is examining three different models for quantifying the economic benefits of avoiding a ton of carbon dioxide. He acknowledged that existing models do not capture a full range of benefits. The economic analyses contain a "sea of uncertainty" for this problem where science "is telling you something is going on" and a decision has to be made. A CCD member spoke of the difficulty of communicating the benefits of climate change regulation, since traditional benefit-cost analysis in currently inadequate. Without benefit-cost analysis, policy makers find that anecdotal information can help them understand the impacts of climate change most effectively. Staff members spoke of the difficulty of communicating climate change information so decision makers are not overwhelmed.

Interview with CCD Managers

Participants:
Ms. Dina Kruger, Director, Climate Change Division
Ms. Rona Birnbaum, Chief, Climate Science and Impacts Branch, Climate Change Division

The managers spoke first about the significant challenges communicating the impacts of climate change and the benefits of climate change policies, because tools for benefit assessment are lacking. Work on the social cost of carbon is nascent. Given the current science, managers are comfortable with strategy that communicates the available quantitative biophysical impacts of climate change and qualitatively describes other impacts. At this stage, a purely economic discussion would not fully address the environmental problem.

Managers noted that there was significant agreement about the known impacts of climate change, although there was some dispute about the degree of adversity associated with some of the projected effects.

CCD relies on the science provided by recent major assessments, but EPA's needs are broader, in part, than those science assessments, because EPA's scope is multi-scale including national, while many assessments are international or regional. Many international assessments haven't quantified effects at a scale that will support future EPA rulemakings. In the long term, EPA's goal is to integrate the science by quantifying health and ecological effects and monetize them by using appropriate economic models, but currently CCD is taking a more basic approach and leveraging available science to support policy.

The CCD managers acknowledge that future climate change regulations will call for more consideration of marginal costs and benefits and for a full reflection of benefits.

SAB members asked the CCD managers to identify other barriers to science integration than the tight timeframe for the endangerment finding and barriers to full benefit cost analysis. One manager observed that the Global Change Research Program might be enhanced by a mechanism for enabling input from policy analysts and developing science products that might be directly helpful for decision making. She also noted that various climate change bills provide limited consideration of the human health drivers for climate change policy; such language could help agencies develop comprehensive policies.

EPA Office of Air and Radiation Office of Air Quality Planning and Standards (OAQPS)
Science Integration for Decision Making Fact-Finding Interviews
January 12, 2010
Research Triangle Park, North Carolina

Two members of the SAB Committee on Science Integration for Decision Making conducted three interviews in EPA's Office of Air Quality Planning and Standards (OAQPS): Drs. Rogene Henderson and Thomas Wallsten. For each interview, Dr. Anthony Maciorowski, Deputy Director of the SAB Staff Office, provided a brief introduction to the purpose of the interview and the Designated Federal Officer, Dr. Angela Nugent, took notes to develop a summary of the conversation. All interviewees were provided a copy of the committee's Preliminary Study Plan in advance.

Dr. Maciorowski noted in each interview that the purpose of the interview was to help SAB Committee members learn about OAQPS's current and recent experience with science integration supporting EPA decision making so that the SAB can develop advice to support and/or strengthen Agency science integration efforts. Dr. Maciorowski thanked participants for taking time for the interviews and thanked Dr. Bryan Hubbell for serving as liaison with the SAB Staff Office in planning the interviews

EPA OAQPS Managers' Perspective (9:00 a.m. - 10:30 a.m.) Participants:

Ms. Lydia Wegman, Director, Health and Environmental Impacts Division
Dr. Bryan Hubbell, Senior Advisor for Science and Policy Analysis for the Health and Environmental Impacts Division

The Health and Environmental Impacts Division has responsibility for managing EPA's National Ambient Air Quality Standards (NAAQS), air toxics and residual risk program, air components of the great waters program, and coordination with international organizations on air quality issues. OAQPS has an increased interest in climate change and its relationship with air quality. There is an increasing awareness that air quality problems are global and solutions are global as well. OAQPS has taken on new tasks related to international air quality. One example is a recent report to Congress on black carbon related to open fires in developing countries.

EPA's Office of Air and Radiation works with its two external scientific advisory groups, the Clean Air Scientific Advisory Committee (CASAC) to integrate science related to air quality, atmospheric chemistry, exposure, epidemiology, and toxicology and the Advisory Council on Clean Air Compliance Analysis to integrate those sciences with economics. OAQPS works "hand in hand" with these committees as it develops the science to support regulatory actions. OAQPS also has benefited from National Research Council reports on air quality management in the United States and has undertaken expert elicitation work and meta-analyses at NRC's suggestion.

The 2007 ozone standard highlights issues related to science integration. Currently, the EPA Administrator is reconsidering the science made available in 2007 and may put different weight on different aspects of the science than EPA's previous Administrator. The previous

Administrator emphasized uncertainties associated with one key epidemiology study and set the ozone standard outside the range CASAC advised. The current Administrator is placing more weight on that study. Science is never 100% clear. Similarly, EPA is reconsidering whether there should be a separate secondary (welfare based) standard to protective sensitive vegetation from seasonal exposures to ozone. The previous administration, after receiving a communication from OMB, decided that the primary and secondary standards should be identical, but the current Administrator is reconsidering the science supporting the need for a separate secondary standard protective of ecological endpoints.

The Clean Air Act requires EPA to protect public health at a level "allowing an adequate margin of safety… requisite to protect the public health." Decisions about the NAAQS require judgment about the requisite level and the margin of safety. EPA administrators have differed in their interpretation of these terms and the different weights they place on science generated by OAQPS, CASAC advice, and science provided by external parties Courts historically have deferred to EPA if the Agency has provided adequate justification for standards.

OAQPS looks to ORD to provide the key science needed to support the NAAQS. At the start of each NAAQS review cycle, ORD convenes a public workshop to identify key new science published since the last NAAQS review that would inform EPA's NAAQS review. Currently, ORD develops an Integrated Science Assessment (ISA) reviewing the nature and significance of key science from multiple disciplines that will inform the NAAQS. After the ISA receives CASAC peer review, OAQPS uses the ISA to develop decision-relevant risk and exposure assessments and a Policy Assessment. All these key documents receive separate CASAC peer review. Once those reviews are complete, OAQPS develops a range of options for the standard for the Administrator to consider, and based on her decision, develops a proposed rule. The Office of Management and Budget coordinates an inter-agency review process for federal agencies with interest. The Department of Energy and U.S. Department of Agriculture play a major role, and the Council of Environmental Quality and Council of Economic Advisors also offer comments about EPA's options and the use of science.

A separate division in OAQPS supports regional implementation of air quality standards by providing assistance with air quality modeling. The Health and Environmental Impacts Division also develops air toxics risk assessments and provides science support to regions. The Division develops the National Air Toxics Assessment (NATA) that provides data at the census tract level. NATA is limited by the available data. The division provides tools and training to states and regions so they can conduct area-specific air toxic assessments.

EPA may not consider costs in setting the NAAQS, but EPA has developed benefit-cost assessments because the NAAQS are significant regulatory actions that trigger benefit-cost requirements of Executive Orders 12866 and 13422. OAQPS uses different air quality exposure and risk analyses for assessments designed to help set NAAQS standard compared with air quality analyses used as input for NAAQS benefit assessments. The exposure and risk assessments designed to help set NAAQS standards focus on 15 areas where EPA has greatest confidence about the science related to key impacts. Benefit assessments, in contrast, focus on the total benefits of implementing regulations in the future. Because they are aimed at implementation, and because they will be compared with comprehensive cost estimates, benefits

analyses are as comprehensive as possible. Because of their different purposes, the analyses have different linkages to air quality and exposure data.

Although benefits analyses are difficult to communicate and no decision is ever made on the basis of benefit-cost analysis alone, the public and other federal agencies have shown great interest in OAQPS benefit assessments. The value of reduced risks of premature mortality and chronic disease impacts, including heart attacks and chronic bronchitis represents 95% of total benefits for the particulate matter NAAQS. OMB's previous Administrator of Information and Regulatory Affairs, John Graham, was persuaded by the benefit-cost analysis to support EPA's non-road diesel rule, particulate matter NAAQS, and the Clean Air Interstate rule.

Communication of uncertainties plays a big role in science integration for decision making. Agency analysts invest large amounts of time and money in uncertainty analyses, but it is difficult to communicate uncertainty to busy managers. OAQPS may have only 45 minutes to describe to the Administrator the science rationale and uncertainties underlying the NAAQS. Many important nuances can be lost.

In addition, the characterization of uncertainty creates an "uncertainty feedback process." The more uncertainty surrounds regulatory science, the more EPA encounters delays. Industry uses the uncertainty and delays to argue that EPA should wait until more science develops.

EPA analysts are not ready to conduct value-of-information analyses to guide their overall analytical approach. The policy-relevant question is framed as "what is the right level of the standard to protect public health." OAQPS presents a range of possible levels supported by the science, but typically an Administrator does not want to explore the populations who would and would not be protected by different levels within that range. Instead, the policy discussion revolves around the uncertainties involved in protecting public health at different points within the range. OAQPS provides information regarding numbers of potential non-attainment areas at different points within the range.

Impediments to science integration include:

- Availability of knowledgeable, experienced staff.
- Lack of time to conduct analyses because of court-ordered deadlines.
- Providing a continuous flow of resources to support costly risk and exposure analyses.
- Lack of a paradigm or approach for analyses supporting environmental justice policies
    - Need for problem formulation to clarify environmental justice policy goals for the NAAQS program, residual risk, and air toxics.
- Need to increase understanding of fate and transport and continuously improve air quality modeling and monitoring.

Meeting with Scientists in the Office of Air Quality Planning and Standards OAQPS (12:00 - 1:30 p.m.) Participants:

Mr. Tyler Fox, Leader of the Air Quality Modeling Group
Dr. David Guinnup, Leader of the Sector-Based Assessment Group
Dr. Bryan Hubbell, Senior Advisor for Science and Policy Analysis for the Health and Environmental Impacts Division

The discussion first focused on the work of the Air Quality Modeling Group (AQMG), which provides input for OAR risk and exposure analyses, regulatory actions, and benefit analyses and provides guidance to states to help develop State Implementation Plans, and the risk and benefits analyses conducted by the Health and Environmental Impacts Division. The AQMG works with ORD and the atmospheric chemistry community to develop and apply air quality models. The group also evaluates air quality models against ambient monitoring data in light of the specific policy questions to be addressed.

OAQPS uses economists and physical scientists to develop and explain models that integrate information across different scientific disciplines. Decision makers often have difficulty understanding technical aspects of models and complex model outputs.

OAQPS primarily provides grants, guidance, and technical support to states for air quality modeling and some limited support to regional modelers. OAQPS relies on regional modelers to know local conditions, but one interviewee commented on reductions in scientific and technical expertise in the modeling area in some regional offices.

There is great potential for regional modelers to develop conceptual models of air quality problems specific to their regions/local areas and plans for field study, monitoring and modeling specific to the geography, meteorology, and political issues. SIPs have not resulted in reduced air pollution, compared to effects from reductions from national Federal programs on utilities and mobile sources, and sector-based Maximum Achievable Control Technologies rules for air toxics. Regional modelers have a role to play in identifying drivers that could reduce pollution in their unique areas.

Resources for monitoring "ebb and flow." EPA needs air quality monitoring for regulatory, scientific (including health effects studies), and model evaluation purposes, but resources for modeling are limited. Placement of monitors and monitoring strategies are principally determined by regulatory needs, but it is important to use monitors to drive future health research. Both the NAAQS and air toxics programs need air quality monitors. While there are about 1,000 ozone monitors nationwide (with only a few in rural areas), there are only 29 monitors providing information on ambient concentration trends for selected air toxics.

It is difficult to coordinate OAQPS's research needs in the modeling, exposure, and air toxic areas with ORD's research efforts, a very different situation from ORD's partnership with OAQPS for the NAAQS process. As a result, OAQPS often turns to universities and experts outside EPA when science questions arise that OAQPS scientists can't address and for which ORD is not positioned to respond in a timely manner for policy purposes.

Uncertainty analyses associated with air quality models are highly complex. OAQPS uses such information primarily to evaluate models and to identify strategies for improving modeling science and performance. Uncertainties are difficult to communicate to decision makers and are most often communicated through discussion of different scenarios via “sensitivity analyses”. OAQPS does not generally quantify these complex model uncertainties as part of regulatory analyses.

Air toxics offer a contrast to the NAAQS modeling program. EPA's limited information for air toxics principally relies on emissions inventories voluntarily provided by states. EPA conducts investigations and administers industry questionnaires to understand emissions and exposures to air toxics. EPA focuses on known sources, such as petroleum refineries, which have developed methods for quantifying emissions. ORD provides some science on emissions measurement and factors that could serve as surrogates for air toxics. None of these methods provides information that decision makers can use with great confidence. OAQPS uses uncertainty analysis to determine where to target resources. One area could be variable exposures to populations within an exposure pattern. Another area may be emissions of ammonium, hydrogen sulfide, and volatile organic compounds in animal feeding operations.

The discussion turned to new modeling efforts related to climate change issues. New opportunities for science integration include:

- Collaboration with ORD to link global and regional-scale models that will allow regions to evaluate climate change policies and their effectiveness.
- Working with states and others on model applications that would evaluate particulate . matter or ozone strategies that can reduce pollutants and also mitigate greenhouse gases.
- Modeling of black carbon and ozone and their contribution to climate change.

The discussion concluded with a discussion of drivers and impediments to science integration.

- Limits of monitoring are bringing people increasingly to air quality modeling.
- Air quality modeling offers a tool for science integration because many processes resulting in air pollution are nonlinear.
- Formulation of problems is often driven by politics, not science. In California and the Chesapeake Bay, for example, decision makers dismissed agriculture as a potential source of air pollution for which to seek controls.
- Effective modeling depends on problem formulation/conceptual modeling, but states and the Agency often do not engage in problem formulation or don't document the process
    - Near-roadway exposure analysis, for example involves many complex factors: diurnal emissions profiles and microscale meteorology and chemistry.
    - Dialogue across scientific communities is needed to identify key questions and most important variables.
    - Need to foster expertise through experiences gained from in-house applications of models and enable value added interpretations to decision makers. EPA cannot simply refer a model to a contractor to plug in values, run the model, and generate results. Such results will likely not be useful to decision makers.

EPA Office of Air and Radiation Office of Transportation and Air Quality (OTAQ)
Science Integration for Decision Making Fact-Finding Interviews
November 19, 2009
Washington, DC

Four members of the SAB Committee on Science Integration for Decision Making interviewed the OTAQ Office Director: Drs. John Balbus and Thomas Wallsten conducted the interviews in person and Drs. Thomas Burke and Thomas Theis participated by phone. Following that meeting, Drs. John Balbus and Thomas Wallsten conducted an interview with OTAQ scientific staff. For each interview, Dr. Vanessa Vu, Director of the SAB Staff Office, provided a brief introduction to the purpose of the interview and the Designated Federal Officer, Dr. Angela Nugent, took notes to develop a summary of the conversation. All interviewees were provided a copy of the committee's Preliminary Study Plan in advance.

Dr. Vu noted in each interview that the purpose of the interview was to help SAB Committee members learn about OTAQ's current and recent experience with science integration supporting EPA decision making so that the SAB can develop advice to support and/or strengthen Agency science integration efforts. Dr. Vu thanked participants for taking time for the interviews.

Interview with Ms. Margo Oge, Director

The committee members asked Ms. Oge to discuss the extent to which science is integrated into OTAQ decision making and the barriers to using science. They asked her to reflect on specific OTAQ decisions and comment on her role, the process for using science, decisions about different levels of analysis needed, and the role of stakeholders and external scientific communities.

Ms. Oge told members that two thirds of OTAQ's 400 employees are scientists or engineers with technical background. She estimated that 40-50% of those employees hold master's or Ph.D. degrees. In her view, OTAQ's effectiveness depends on the talent of engineering, scientific, policy, and legal. The diversity of the staff is also a strength. Staff are often hired from industry EPA regulates and as a result OTAQ includes people who understand specialized technology, e.g., refinery technology engine manufacturing, or lawn mowers.

She then outlined the statutes that provide the mandate for OTAQ's work. OTAQ implements Title 2 of the Clean Air Act, which provide specific decision criteria for setting standards for mobile sources and their fuels, along with discretion in how those criteria are to be used. OTAQ also has been charged with implementing several provisions of the Energy Independence and Security Act (EISA), which includes a mandate for a renewable fuel program. This law provides less flexibility and discretion and the science involved is "very young," especially compared to laws governing regulation of criteria pollutants.

OTAQ's authority to set standards for on-road and nonroad engines springs from the 1990 Clean Air Act Amendments. Those amendments are technology-forcing; the Administrator signs rules and OTAQ implements the programs. In the case of diesel engines, the rule had the goal of

reducing nitrogen oxides by 90% to 95%. The rule gave the industry 4 to 6 years for implementation of the technologies to achieve these reductions. In the case of the heavy-duty truck rule, the industry challenged implementation in court. The court responded that EPA's engineering assessment explained the technology pathway that will be available to implement the program.

Ms. Oge noted that OTAQ's work involving science had three major parts: mobile source decisions affecting criteria pollutants, decisions under EISA, and work over the past two-to-three years on climate change.

For criteria pollutants, EPA must demonstrate that sources contribute to human health risks and conduct a cost/benefit analysis for significant rules. The first test is a scientific test, and assessment information is developed by OAR's Office of Air Quality Management and Standards. For the diesel decision, her office asked for CASAC review "to get more clarity on the impacts of diesel." The review took five years and CASAC agreed that diesel exhaust is a probable carcinogen. That finding, along with the finding related to the Particulate Matter (PM) National Ambient Air Quality Standard (NAAQS) allowed EPA to move ahead to set stringent regulations. Science for diesel programs was strengthened by external peer review.

A committee member asked how OTAQ handled the link between air pollution exposures and health effects and how OTAQ addressed uncertainties. Ms. Oge responded with an example. OTAQ used assessments of public health and welfare effects from an air quality analysis of truck and bus PM emissions provided by OAQPS. OTAQ then identified technologies to help maximize reductions of PM reductions, such as requiring catalytic converters for diesel engines and changing diesel fuel to reduce sulfur. OTAQ conducted engineering and cost analyses to determine the sulfur reductions needed in diesel fuels to reduce PM exhaust from catalytic converters by 90%. OTAQ worked on cost estimates with industry experts who understood catalytic converters. The final benefit-cost analysis supporting the diesel rule determined that there were $70 billion in public health benefits and $4 billion in costs. This decision was a prime example of OTAQ's use of science, engineering analysis, and benefit and cost estimates. There is no one simple "recipe" for science supporting a decision; each decision is unique. For the health and welfare assessments, OTAQ relies on the characterization developed by OAQPS.

A member asked whether cost estimates were as open to public comments as health assessments and noted that the cost estimate was prepared with industry input. Ms Oge responded that OTAQ reaches out to all stakeholders. It is important to reach out to everyone likely to be affected by an upcoming decision. OTAQ reaches out to leaders within the automobile industry, including Japanese and German car companies. Trained experts can challenge EPA's analysis. In addition, OTAQ's facilities in Ann Arbor can test emission estimates for cars and SUVs. Such testing can verify whether industry or EPA's cost estimates were accurate.

A member asked about the range in variation in cost estimates from industry sources. Ms. Oge responded that estimates may vary by a factor of two. The Clean Air Act doesn't require benefit-cost analyses. Historically OTAQ regulations have had very high benefit-cost

ratios. Future regulations, such as mandatory retrofits of existing diesel trucks, may involve higher costs, and will involve weight-of-evidence decisions.

Ms. Oge next discussed EISA, which calls for the generation of 36 billion gallons of renewable fuel by 2022, including 15 billion from conventional corn ethanol and the remainder from advanced biofuels. EISA mandates that EPA conduct a lifecycle analysis that includes analysis of indirect land-use impacts for each feedstock to establish a threshold. The lifecycle analysis must determine a 20% increase in greenhouse gas emissions for corn-derived fuels and 50% to 60% for other fuels for the fuel to be used. This analysis was used in the proposal to identify fuels that qualify for the four different renewable fuel standards.

Ms. Oge described the challenges presented by this mandate. Lifecycle greenhouse gas assessment in a regulatory program was required by EISA for the first time. EISA only allowed one year to develop a proposed rule. To meet these challenges, OTAQ examined two different models and used satellite data to support the rulemaking. She acknowledged that indirect land use impacts are significant and very uncertain, because the economics and ecological assessments underlying them are complex. OTAQ has conducted a formal uncertainty analysis for the ongoing renewable fuels program. The office has never conducted such an analysis before; the most sophisticated previous OTAQ uncertainty analysis has involved sensitivity in analysis. EPA plans to finalize its renewable fuel standard rule in January and will bring the lifecycle assessment methodology to the SAB for review.[1]

Within the tight time constraints available for the proposed and final rules, OTAQ sought contractor panel peer review for the lifecycle analysis. The panels were composed of experts from different disciplines and provided "incredibly useful input." Within the mandated timeframe OTAQ needed to largely draw on existing models and data. She noted that some commenters on the proposed rule took issue with EPA's analysis of international lifecycle impacts, but EPA legal experts noted that EISA required the international analyses.

An SAB committee member noted the contrast between controversy over an "over studied" chemical like dioxin and the potentially profound changes related to the renewable fuel standards, which are supported by science that is not well developed. Ms. Oge acknowledged the contrast. The mandate to address renewable fuels came from Congress, which required EPA to use EISA as a tool to address climate change.

Ms. Oge acknowledged that lifecycle analysis for renewable fuels needs research. She then commented on how OTAQ partners with other organizations to strengthen the science base of its activities. OTAQ works actively with the Department of Energy on all fuel-related activities. It is also working intensively with DOT on the next version of vehicle greenhouse gas regulations that will factor in electric cars and hybrids. OTAQ also works closely with the State of California and theirstrong technical staff. She noted that OTAQ sought advice from the National Academies of Science (NAS) on inspection and maintenance and that NAS review influenced EPA's latest mobile source models. OTAQ also seeks information from the Health Effects Institute on emerging issues. Stakeholders also need to be listened to; stakeholder

[1] In a communication subsequent to the interview, OTAQ staff informed the SAB that the Agency plans to bring the document to the National Academy of Sciences, rather than the SAB, for review.

feedback identified that EPA had underestimated particulate matter emissions from diesel engines.

When asked to comment on ORD's contributions to OTAQ's program, Ms. Oge commented that ORD's work on the ozone and PM NAAQS had a huge effect. ORD's testing for near-roadway exposures is also very crucial for nitrogen oxide NAAQS. She would like to see more ORD staff work on broad impacts of biofuels, not just air pollution, but also impacts on water and land use impacts and new types of fuels.

A member asked about how OTAQ evaluated its use of science. Ms. Oge responded that OTAQ's Ann Arbor laboratory provides retrospective evaluation. Testing cars after they've accumulated mileage can be used to verify that vehicles continue to meet emission standards over time.

Interview with OTAQ Staff Scientists

OTAQ Participants:
Mr. Vince Camobreco
Mr. Ken Davidson
Mr. Chad Bailey

An SAB committee member asked how EPA handles stakeholder involvement in the science assessment process, especially how it handles scientific studies brought by outside stakeholders. An EPA scientist responded that for the renewable fuel standard, EPA held a two-day workshop to get public input and then conducted peer review on four different aspects of EPA's lifecycle analysis. The peer review provided helpful expert guidance to identify areas to improve. He noted that OTAQ reaches out to other parts of EPA to get help evaluating the science provided by outside groups. As a project manager, he filters incoming science and outside comments and identifies issues for managers' attention. Some comments are tested or evaluated with the model.

The staff person commented on the significance of OTAQ's use of a lifecycle model for demonstrating whether renewable fuels have reduced greenhouse gas impacts. He noted that this was the first application of lifecycle analyses for regulatory purposes. He acknowledged many uncertainties related to direct and indirect effects both within the United States and internationally.

In terms of addressing uncertainty bounds, OTAQ focused on sources of major impacts and conducted a sensitivity analysis.

When asked about improvements that would help the integration of science for decision making, he responded that the time constraints associated with the mandate proved challenging for science integration. It would have been helpful for Congress to provide more time for the analytical tasks mandated by EISA. He noted that OTAQ plans to work with the SAB and National Academy of Science on the next iteration of the renewable fuels standard. When asked

whether OTAQ made use of modeling guidance provided by EPA's Council on Regulatory Environmental Models (CREM), he noted that the CREM guidance was useful, but that each rulemaking and analytical approach is unique. For example, the best available models used in the lifecycle analysis were complex and specialized and difficult for the public to replicate.

Although the actual lifecycle analysis was conducted in record time, OTAQ had the benefit of preparation thinking about the lifecycle issue through prior problem formulation activities. In 2005, EPA received public comments related to the indirect effects of biofuel use as part of the Renewable Fuel Standard 1 rulemaking. OTAQ developed an in-house, interdisciplinary team that developed an understanding of the issues through working iteratively and bringing additional experts into the discussion at EPA, and through contracts, grants, and discussions with USDA. EPA staff gained knowledge about lifecycle assessment through workshops and conferences.

Other OTAQ staff agreed that OTAQ scientists stay current in their field by reading ORD assessments, attending professional meetings and workshops, and interacting with review panels. OTAQ scientists and engineers participate in ORD's research planning process and are actively involved with the research planning process at the Health Effects Institute. There is also a coordinating research council for the oil and automobile industries.

OTAQ staff talked briefly about their use of stakeholder science. Work on fuel standards has stakeholders "very plugged" into discussions of technical feasibility. Automobile manufacturers share information about what companies have been doing and react to options. These stakeholder conversations give OTAQ scientists and engineers a "sense of what the industry able to do when it's really stretching."

The staff were asked to reflect on their experiences with science integration generally. One scientist noted that the criteria pollutant program has a relatively well established process of literature review and internal and external review. Those processes promote science integration. He also noted that EPA's rule development process and inter-agency review process encourage EPA to think about science issues and decision making in an integrated way.

Another member responded that OTAQ has fairly well established procedure for rulemaking analyses. Teams include fuel experts, motor vehicles engineers, experts in refining technology, air quality experts, and economists. The teams meet at the start of a rulemaking to map out needed areas of analysis. Everyone listens and information exchange happens almost on a weekly basis.

An OAR staff member noted that decision makers often focus on the technical analyses underlying rules and decision makers take time to understand the technical dimensions of problems. They need to understand the technical issues and related uncertainties -- and who's affected by those uncertainties--before they can make decisions using the "policy construct" (e.g., the margin of safety or benefit-cost ratio) to make a decision. Every decision is multi-factorial and managers need to understand the technical components.

Science Integration for Decision Making Fact-Finding Interviews
EPA Office of Prevention, Pesticides and Toxic Substances (OPPTS)
January 26, 2010,

Six members of the SAB Committee on Science Integration for Decision Making conducted five interviews with managers and scientists in the Office of Prevention, Pesticides and Toxic Substances (OPPTS). Drs. James Burke, Buzz Thompson, and Penny Fenner-Crisp in person and Drs. James Bus, Jill Lipoti, and Thomas Theis by telephone. For each interview, Dr. Anthony Maciorowski, Deputy Director of the SAB Staff Office, provided a brief introduction to the purpose of the interview and the Designated Federal Officer, Dr. Angela Nugent, took notes to develop a summary of the conversation. All interviewees were provided a copy of the committee's Preliminary Study Plan in advance.

Dr. Maciorowski noted in each interview that the purpose of the interview was to help SAB Committee members learn about OPPTS' current and recent experience with science integration supporting EPA decision making so that the SAB can develop advice to support and/or strengthen Agency science integration efforts. Dr. Maciorowski thanked participants for taking time for the interviews and thanked Dr. Mary Belefski (observer at OPPTS interviews) for serving as liaison with the SAB Staff Office in planning the interviews.

Meeting with Acting Director, Managers, and Scientific Staff, Office of Pollution Prevention and Toxics (OPPT) (9:00 - 11:00 a.m.)

Participants:

Ms. Wendy Cleland Hamnett, Acting Director
Ms. Barbara Cunningham, Acting Deputy Director
Mr. Jim Willis, Director, Chemical Control Division
Mr. Ward Penberthy, Deputy Director, Chemical Control Division
Dr. Tala Henry, Acting Deputy Director, National Program Chemicals Division
Mr. Neil Patel, Deputy Director, Economics, Exposure and Technology Division
Dr. Kay Austin, Associate Director, Economics, Exposure and Technology Division
Dr. Jennifer Seed, Deputy Director, Risk Assessment Division

The Office of Pollution Prevention and Toxics (OPPT) implements a wide range of programs. Under the Toxic Substances Control Act (TSCA). TSCA is a risk-benefit statute. Decision makers must consider not only the risks of a chemical, but also the costs and benefits of alternatives. OPPT makes decisions on chemicals that may enter commerce prior to their manufacture within a very short (90-day, and sometimes 45-day) time frame. These decisions are usually taken without detailed exposure and hazard information on the chemicals. The new chemical program uses tools and methods, developed over OPPT's 30-year history in which over 45,000 new chemicals have been evaluated. In OPPT's existing chemical program, there is no mandatory requirement to periodically review chemicals in commerce. The program takes action only when issues are identified. It is difficult to ban or restrict the manufacturing processing, use or disposal of existing chemicals because the statute has a relatively high threshold for this type of regulatory action (i.e., that a chemical " *presents or will* present an unreasonable risk"). In regulating existing chemicals, OPPT has more frequently required

chemical testing, issued significant new use rules (SNURs) or issued information reporting rules to collect hazard and exposure data from companies. These rules have statutory standards that are easier to meet.

OPPT also has chemical-specific programs polychlorinated biphenyls (PCBs), lead-based paint, and asbestos. The office has the lead for promoting pollution prevention across the Agency. OPPT manages EPA's "Design for the Environment" program, which promotes the use of safer chemicals and safer alternatives.

There is a scientific component to all these decisions that varies, depending on the nature of the decision and the regulatory findings that are necessary to justify it. OPPT conducts screening level assessments for new chemicals, in-depth regulatory risk assessments, and scientific assessments "in-between" that vary in complexity. Similarly, risk management decisions are made at many levels of management. Most decisions in the new chemical program related to premanufacture notifications (PMNs) are delegated to the branch level. Decisions on existing chemicals may be made by the Assistant Administrator for OPPTS or, in some cases, by the EPA Administrator, depending on the scope of the decision.

To evaluate PMNs, OPPT uses a tiered screening process. Science drives most of the decisions. Interdisciplinary groups of toxicologists, economists, and exposure scientists hold a series of meetings to evaluate available information on new chemicals and to recommend whether a chemical should enter into commerce with or without restrictions or testing requirements, whether it meets one of the 5(h)(4) exemption requirements. If a chemical is a potential concern, scientists develop more detailed exposure and hazard assessments. Decisions may then be made at the Division Director-level about test requirements or other restrictions on a new chemical. OPPT economists typically don't conduct an economic analysis for every chemical, because most chemicals present "no concern."

There is no requirement under TSCA to test a new chemical before a PMN is submitted. PMN submitters must only provide data in their possession. EPA, as a consequence, often seeks information from other sources, most commonly analogue chemicals through use of Structure Activity Relationships. It has also developed models to supplement available data [e.g., the Estimation Programs Interface Suite (EPI SuiteTM)] and has worked to get these models peer reviewed. If necessary, EPA has the authority to require a PMN submitter to test their chemical as part of the PMN review process.

For nanotechnology products, OPPT is building on its experience in the new chemical program and is exploring how best to evaluate these substances and protect against unreasonable risks. OPPT works closely with the Organization for Economic Cooperation and Development (OECD) and is evaluating whether OECD testing programs for nanomaterials are relevant for TSCA regulatory needs, as well as ORD, which is devoting significant resources towards research on and testing of nanomaterials. OPPT is currently regulating all nanomaterials reviewed through the new chemicals program to protect against human or environmental exposures, and to generate test data. OPPTS recently announced that it would also be regulating and testing nanomaterials based on existing chemicals as well.

For the existing chemical program, OPPT has mechanisms to coordinate with other EPA offices. In the case of perfluorooctonoic acid (PFOA) and the voluntary phase-out of PFOA, OPPT reached out to ORD and academics and formed a team to develop research to help understand the risks presented by PFOA substitutes coming into the new chemical program. The research group meets once a year to review research and monitor progress. OPPT also coordinated with the Office of Water to assist them in developing water criteria for PFOA. OPPT relies on Agency guidelines (e.g., Risk Assessment Forum guidelines, Economic Analysis Guidelines) in regulatory decision making.

Advances in science pose challenges for OPPT, because it is not clear how some new science will be integrated into the OPPT decision making. Advances in biomonitoring, for example, show presence of chemicals in tissues, but it is hard to make risk management decisions solely on that information. OPPT must also understand the chemical's source and exposure pathways; much additional information must be gathered and analyzed before OPPT can take regulatory action. For example, the new chemicals program has received genomics data and must determine how best to integrate it into a new chemical TSCA Section 5 decision to protect against unreasonable risk of injury to health or the environment. Another developing hazard assessment approach, computational toxicology is a concept familiar to OPPT because of its experience with Structure Activity Relationships (SAR). Computational toxicity has a role as one part of a "weight-of-evidence" analysis, but there is a danger of "overselling" computational toxicology results, especially if EPA cannot back it up with evidence showing a biological basis for toxic action. Science may soon provide reliable computational toxicology results for cancer effects, but animal testing may still be needed for non-cancer effects, especially developmental effects.

Possible reauthorization of TSCA has raised policy issues for which OPPT and EPA may not have adequate science or assessment methodologies or tools. One area is cumulative risk. Different chemicals and different risk management situations may raise very different scenarios and it would not be desirable to have a standard suite of tests or a standard approach to every situation. ORD's work to date on cumulative risk is generic; it considers impacts on a receptor, interactions across chemicals, and interactions across effects, but the analysis discussed to date is not designed to help decision makers in regulatory programs with distinct needs. Under TSCA, for example, EPA regulates uses and needs to consider alternatives. Consideration of cumulative risks in this context is complicated. To be practical, cumulative risk methods need to be designed with EPA statutes and EPA decision makers in mind.

The Risk Assessment Forum is an important Agency mechanism but is not as productive as it should be. Participants do not have enough time to contribute in meaningful ways.

Impediments to science integration include:

- Different and limited authorities across federal agencies to address risk. U.S. Department of Agriculture and the Food and Drug Administration, for example, had limited authorities to supplement EPA in addressing the risks presented by PFOA and PFOS.
- Lack of information on exposures. OPPT generally does not know how chemicals are being used and the nature of human exposures and environmental releases. Often even manufacturers have no information about how customers use their chemicals.

- Lack of legislation requiring life-cycle information.
- IRIS values, if they exist, may not be appropriate for OPPT needs. IRIS values generally assume continuous low exposure, an assumption appropriate for water or ambient air, but OPPT chemical exposure could be intermittent, involve acute 1-day exposures, or a variety of scenarios that may make use of an IRIS Reference Dose inappropriate.
- Not all managers and staff are skilled at "asking the right questions" to guide scientists in "putting the science together" for problem solving and risk management decisions. Sometimes there is a need to push for interactions between divisions for a meaningful problem formulation to assist with decision making. OPPT doesn't always employ a formal problem formulation discussion for projects.

It has been difficult to find new scientists to conduct OPPT risk assessments. Toxicologists who have recently graduated have backgrounds in computational toxicology or molecular genetics and often have little or no experience with whole animal toxicology. OPPT needs scientists who can understand and evaluate both kinds of information. OPPT also needs epidemiologists, experts in biomonitoring, environmental fate, and statistics. Participants noted that OPPT scientists were generally lower in grade than ORD scientists and that OPPT had no title 42 positions.

Funds for training are generally available and scientists have the funds and time to attend professional conferences. Scientists are mostly trained "in house" to conduct OPPT-type reviews. OPPT has provided funding for graduate training for personnel in different areas including industrial hygiene.

SAB advisory reports are generally valuable. Peer reviews of specific technical documents are useful for OPPT, but SAB's slow response is an issue. SAB consultations are useful for programs in their early stages. It is helpful when SAB recommendations provide a general framework on a science issue. In contrast, it is difficult when SAB recommendations are specific and do not recognize specific restrictions of legislation. In addition, sometimes the SAB makes recommendations for actions already underway at EPA.

OPPT follows formal notice and comment processes and formal guidance on how to interact with stakeholders.

Meeting with Deputy Assistant Administrator, Office of Prevention, Pesticides and Toxic Substances (OPPTS) (11:00 a.m. - 12:00 p.m.)

Participant:

Mr. James (Jim) Jones, Deputy Assistant Administrator

The Deputy Assistant Administrator drew on his past experience as a Branch Chief, Division Director, and Office Director, as well as his current experience in responding to the committee's science integration questions. He began the discussion with a description of his efforts integrating computational toxicology into the work of OPPTS. His interest in computation toxicology sprang from an awareness developed seven years ago as a Division Director that the Office of Pesticide Program's animal testing regime was unsustainable and that

there was a need for an alternative testing approach. Since that time, he has developed a relationship with ORD scientists pioneering the computational toxicology program. This relationship was reinforced by the 2007 NAS Report, *Toxicity Testing in the 21st Century; a Vision and a Strategy*. As Deputy Assistant Administrator, he has brought the risk assessment and risk management leadership in OPP and OPPT into dialogue with ORD scientists. These interactions have dramatically influenced how ORD is approaching toxicity testing and has made OPP and OPPT aware of the potential applications of computational toxicology.

He noted that the nature and level of his involvement in this emerging science issue was not typical and gave him a unique perspective. He also noted an interest in encouraging other parts of EPA, especially the Office of Water, to deepen their knowledge of the potential of the computational toxicology program for achieving EPA's mission. He expressed appreciation for ORD's receptive response to his desire for more interactions with his office.

To facilitate ongoing interactions between OPPTS and ORD, the Deputy Assistant Administrator has scheduled day-long meetings for ORD scientists to report on their progress and for OPPTS managers and scientists to talk with them about applications. These sessions are separate from ORD's research planning process. Each time the meetings happen, "new light bulbs go off." OPPTS will have a need to conduct assessments for about 40,000 chemicals and OPPTS managers are beginning to see the potential value of computational toxicology research.

He noted that other agencies, such as the National Institutes of Environmental Health Sciences, are aware of and engaged with ORD's Computational Toxicology Research Center.

The Deputy Assistant Administrator also described his role as a "co-lead" on the Science Policy Council's (SPC) subcommittee for science policy priorities. He volunteered for this project to help focus the agenda of the Science Policy Council to deal with more executive-level issues. The Subcommittee's draft science priorities (Climate and Energy, Environmental Contaminants, Security and Emergency Response, and Modernization of Infrastructure) were chosen before the Administration changed and may need to realign with current priorities of the Administrator. In discussions with regions and headquarters, he found that each priority has a research component and a link to decision makers in national program and regional offices.

"Stove-piping" by organization is a barrier to science integration. EPA must organize itself in some fashion to implement its many programs, but any organizational structure creates institutional barriers. Even two programs as similar as OPP and OPPTS are dramatically different institutions and have different cultures that developed from statutory requirements.

If EPA has the authority to hire new personnel, it is not a problem to find the right people. Although there are problems with hiring at EPA, "when we focus energy on hiring the right people, we get them." People are attracted by the mission, want to do meaningful work, and are relatively well paid.

The ORD IRIS system has not historically been critical to OPPTS. In the past 15 years, OPP did not often rely on IRIS. OPP needed so many chemical assessments, largely for

chemicals only regulated by OPP. Historically, OPPT has not regulated existing chemicals, so it has not needed IRIS information. The Deputy Assistant Administrator noted, however, that OPPT will soon become a "big regulator" for chemicals. OPPT plans to conduct safety assessments for 12 industrial chemicals and take action, so OPPT will soon "become a big user of IRIS." The IRIS program fits naturally with the Administrator's concept of "One EPA." Although it will be a challenge to coordinate OPPT's needs with those of other offices, it is a "production issue" similar to others across the Agency. There will be a need for a schedule for generating IRIS assessments that all EPA managers can access and rely on.

At EPA, OPPTS has the most significant need for science to support decision making related to nanomaterials. The Deputy Assistant Administrator acknowledged a need for coordination and integration with the Food and Drug Administration around methods for analyzing the hazard and fate of nanomaterials - "the fundamental approach should be consistent." He noted that approaches have been better coordinated internationally than across the federal government.

Science integration requires managers to make decisions in the face of uncertainty, because science rarely provides absolute answers to questions of interest to risk managers. The Deputy Assistant Administrator spoke about his general approach, which helps him be "comfortable" in the face of uncertainty. He described an intuitive framework for making decisions, informed by the severity of the effect; the potential consequences of the decision in terms of economic impact; and the potential for long term impact. All those factors "feed into how much information" is needed before he feels comfortable making a decision. For him, the need is often for understanding all the information EPA has available rather than a need for additional information.

To strengthen science integration, the Deputy Assistant Administrator recommended that leaders at the highest level communicate and give consistent cues that science integration is important. Science integration won't happen "by chance;" leaders and managers at all levels and across the organization must be motivated to make it happen. EPA's leadership must send repeated signals and check that science integration is happening. Whether the issue is PCBs and caulk, mountain-top mining, maximum contaminant levels, or environmental justice, there is a need for leadership to encourage parts of EPA to work together and a need for problem formulation that will link science to decision making. When the Administrator identifies a priority and consistently follows up with questions, programs and regions will pay attention and incorporate that priority in their work.

Science integration also opens up possibilities for voluntary programs. If science indicates a need for action, EPA can use voluntary programs, such as Design for the Environment, to address environmental problems.

One area where the Agency as a whole could strengthen science integration is in "after-the-fact" mining of the results of Science to Achieve Results (STAR) grants. STAR grant research is a resource for the Agency, but often the connection is not made with program and regional offices. It is a cross-agency management issue that should be addressed.

Meeting with Director and Scientific Staff, Office of Science Coordination and Policy (OSCP) (1:00 p.m. - 2:00 p.m.)

Participants::

Mr. Frank Sanders, Director
Mr. Steve Knott, Director, Exposure Assessment Coordination and Policy Division (EACPD)
Mr. Gary Timm, Senior Scientist (EACPD)
Dr. Kenneth Haymes, Senior Scientist for Dr. J. Thomas McClintock, Director, Hazard Assessment Coordination and Policy Division (HACPD)
Dr. Karen Hamernik, Senior Scientist (EACPD)

The Office of Science Coordination and Policy (OSCP) does not have direct regulatory responsibilities; it manages various technical projects and provides scientific input to decisions made by others. The Endocrine Disruptor Screening Program (EDSP) in OSCP has the responsibility to standardize and validate the assays used in Tier 1 and Tier 2 of the EDSP and is working with the Office of Pesticide Programs to implement the requirements under the Food Quality Protection Act, which mandated a screening program to focus on estrogenic effects on humans and other organisms. The EDSP in OSCP also provides input to OPPT, the Office of Water, and ORD. OSCP also manages the Scientific Advisory Panel (SAP), a federal advisory committee that provides recommendations to the OPP Director on Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) science issues. OSCEP also provides input on biotechnology input to OPP and OPPT.

OSCP has had success in "breaking down silos that exist" in implementing the endocrine program. Because of the statutory mandate, OPP is requiring tests for all pesticides for endocrine disruption, including estrogen, androgens, and thyroids. The EDSP has validated assays developed by ORD. These assays have been standardized and validated principally using EPA contracts. The purpose of validation is to measure the performance of an assay. The EDSP is working with OPPT and the Office of Water to extend screening for endocrine disruption to work on industrial chemicals. Drinking water contaminants include pesticides, industrial chemicals, pharmaceuticals, disinfection byproducts and degradates. In 1999, the EDSP received a joint review by the SAB and the Scientific Advisory Panel and the EDSP has requested advice from the Scientific Advisory Panel on multiple issues since that date. The EDSP has a good working relationship with OECD which has provided technical support to the EDSP. The Tier 2 assays and many of the Tier 1 screens have been validated in cooperation with the OECD Test Guidelines Program. Test guidelines could be considered a non-tariff barrier, but the 1983 Mutual Acceptance of Data Treaty is the foundation of the OECD test guideline program.

For biotechnology issues, OSCP coordinates with other governments on policies related to genetically modified organisms. Although EPA is "one of few countries" that were not signatories to the Cartagena Protocol on Biosafety, OSCP staff attend meetings implementing the protocol. OSCP staff also works with OECD on harmonization issues related to regulation of biotechnology products within EPA's jurisdiction. OSCP also monitors the status of review of

biotechnology products by the Food and Drug Administration and the U.S. Department of Agriculture. Within EPA, OSCP also assists OPP as needed and provides comments on OPPT biotechnology rules.

In managing the Scientific Advisory Panel, OCSP provides the pesticide program with an efficient mechanism to provide independent scientific peer review. The panel holds about one meeting per month and will soon begin "web-casting" meetings, an important new development that will enhance transparency.

Science integration for the EDSP was facilitated by the Food Quality Protection Act mandate and availability of science to be integrated into EPA programs. ORD provided support for the program in the past and may provide more support in the future through its Computational Toxicology Program.

Barriers to science integration for OSCP include:

- Hiring scientists with the expertise needed by OSCP is a challenge because of the federal government's "long and difficult process to hire people." The hiring process could be streamlined.
- Not all coordination activities important for OPPT and OPP are located in OSCP. It would be helpful if coordination of national test guidelines were also an OSCP lead responsibility.

Meeting with Acting Office Director, Managers, and Scientific Staff, Office of Pesticide Programs (3:00 p.m. – 5:00 p.m.) Participants:

Dr. Steven P. Bradbury, Acting Director
Mr. William (Bill) L. Jordan, Senior Policy Advisor
Dr. Vicki L. Dellarco, Science Advisor
Ms. Joan Harrigan-Farrelly, Director Antimicrobials Division
Mr. Keith Matthews, Acting Director, Biopesticides and Pollution Prevention Division
Dr. Donald Brady, Director, Environmental Fate and Effects Division
Dr. Tina Levine, Director, Health Effects Division
Dr. Edward Odenkirchen, Senior Advisor, Environmental Fate and Effects Division

The Office of Pesticide Programs (OPP) has processes in place to encourage science integration. Most OPP decisions rely on team activities. There are approximately 750 people in OPP, and two-thirds have science degrees. OPP's primary legislation calls on the office to address a wide range of pesticide issues, from classic herbicides, to pheromone-disruption of mating behavior, to disinfections in paints. Some divisions (i.e., the Antimicrobial Division and the Biopesticides and Pollution Prevention Division) contain the multi-disciplinary technical experts and policy analysts needed in most cases to accomplish their mission. Other divisions (i.e., Health Effects Division, Environmental Fate and Effects Division, Biological and Economic Analysis Division) contain technical experts who coordinate with managers who have the lead for registration of new pesticides or new uses or reregistration of existing pesticides. No matter how staff are listed in an organizational chart, OPP's work requires integration of multiple disciplines: chemistry, human health, ecology of different kinds, entomology, economics, and

geographic information system expertise. OPP also reaches out regularly to other parts of EPA for help, especially to ORD and the Office General Counsel. OPP also participates actively in the Agency's Science Policy Council and the Risk Assessment Forum, and considers recommendations from expert review panels such as the National Research Council.

Under its pesticide re-evaluation efforts that address currently registered pesticides, OPP has historically used a process for integrating stakeholders' input into risk assessment and management decisions. Recently, OPP began implementing a public participation process for certain registration actions associated with new pesticides, new uses of existing pesticides, and actions determined to be of significant interest to the public. By establishing these processes, the Agency provides an increased opportunity for the public to provide comments on risk assessments and proposed registration actions on registration decisions at points in the regulatory process when comprehensive information and analysis are available. Such participatory processes improve the public dialogue on pesticide registration decisions, increases the understanding of potential risks and benefits, and contribute to meaningful protective measures.

Within the Antimicrobial Division and the Biopesticides and Pollution Prevention Division, scientists interact within those divisions, with each other, and with staff in the policy branches to determine whether data are sufficient to make sound decisions. If a new or controversial issue arises, scientists consult with colleagues in the Health Effects Division, Environmental Fate and Effects Division or reach out to the Centers for Disease Control, Food and Drug Administration, or national associations such as the American Hospital Association. They also consult the Scientific Advisory Panel and experts in OPPT and ORD.

The pesticide law is a licensing law. New pesticides "come on the radar screen" at the initiative of pesticide companies. Reregistration is a re-evaluation program that focuses on pesticides of greatest risk that have not been reviewed recently. Companies that seek registration or that are subject to reregistration bear the responsibility of providing data for OPP to assess. Data requirements are documented in 40 CFR Part 158. Basic requirements depend on the generic formulation of the pesticide and the intended use and related exposure pathways of the chemical. Basic requirements include testing for human health risk, environmental fate, effects on organisms, and physical and chemical properties. Once OPP receives these data, it follows standard methods and procedures to "make a call about the risk picture."

Early in the problem formulation phase, scientists work closely with risk managers to describe what is known and not known and their "comfort" with existing knowledge related to exposure (e.g., magnitude, distribution and characterization of typical exposures) and effects (integrating results from disciplines with risk quotients with results describing effects in risk outcomes). Scientists describe certainty bounds sometimes numerically, sometimes descriptively. Scientists describe the knowledge lacking for each decision. Consistent consideration of Part 158 data requirements/test guidelines as well as other existing information provides a basis for determining whether additional testing is necessary. This approach provides consistency in applying best professional judgment. The process relies on ongoing discussions with risk managers about risks, including relative risks of alternative pesticides.

In the case of an emerging science issue, like nano pesticides, OPP builds on its existing approach and makes a special effort to integrate science from outside its program. When a registrant recently asked about nanosilver pesticide requirements, OPP asked registrants "what they thought." When the registrant responded that the nano pesticide under development would present no exposures, OPP scientists conferred internally and then conferred with the Food and Drug Administration and ORD. There was no direct precedent or guidance. OPP requested a consultation with the Scientific Advisory Panel, which assembled a group of 30 experts from around the world to identify the data needed for registration and how to assess risks of pesticides containing nanosilver particles.

OPP has an effective organization that encourages science integration. However, OPP continues to look for ways to improve its efficiency and effectiveness. OPP staff are encouraged to reach outside their organizational units and regular interactions when new problems arise and when new science is needed. Concerns about degradation of pesticides may prompt ecologists, for example, to consult with statistical experts in the Health Effects Division. There is also a Science Policy Council within OPP that keeps track of emerging issues and is devoted to science integration for those issues. The Council is successful because it has a charter, clear responsibilities, and operating rules. OPP evaluates the Council's workplans every year.

OPP relies on long-range planning for regulatory decisions to help it think through science integration issues and to plan interactions with other parts of EPA. OPP tries to coordinate with ORD on IRIS chemicals of common interest. OPP has an IRIS coordinator and attends Agency Science Policy Council Steering Committee Meetings.

OPP has taken advantage of international opportunities for science integration to reduce duplicative work internationally among regulatory authorities. Many new active ingredients involve work share and global reviews, which facilitates earlier access to the global market of newer and lower risk chemicals. For example, Australia, Canada, and the European Union have been involved. The countries may divide up initial analysis. OPP may do the residue chemistry and human toxicology and then collaborate and communicate with scientists in other governments. Through discussion, they come to agreement on the scientific endpoints of interest, but may not arrive at the same regulatory decisions because regulatory authorities differ. Collaboration involves work in itself, but OPP reaps benefits from the additional peer involvement and peer review resulting from global review. OPP scientists have gained confidence about their science through these interactions. The collaborative work across several countries also results in a higher degree of public confidence in the regulatory system.

Participants discussed strategies for encouraging science integration at EPA, even though Agency programs face deadlines and are unlikely to receive additional funding for integration. Most importantly, Agency staff need to "internalize the desired outcome" and EPA needs leadership at every level to see that science integration is built into EPA's "Everyday way of doing business." If EPA had the "right people, right vision, and core values," science integration could work more broadly. It is important for EPA to develop leadership and staff that "have a broad sense of what the Agency is all about." Participants gave an example. The pesticide statute requires decisions within a certain frame, but it does not explicitly require consideration of impacts on the Clean Water Act's Total Maximum Daily Loads, and coordination with the

National Marine Fisheries Service, and Fish and Wildlife Service. OPP scientists and other staff think "outside the box" about those other dimensions and have processes and relationships in place to integrate information and coordinate decisions with others. There's a need to recruit, nurture, and guide people to make decisions outside the box, while still making timely decisions. Scientists and managers may need training to be knowledgeable about the potential of programs across the Agency that can be used, in conjunction with their own, to achieve EPA's environmental goals.

It is important for scientists to directly interact with each other across the Agency and to form relationships that can facilitate science integration. Both formal and informal discussions are important. Good ideas also can come out of informal interactions (e.g., at professional meetings). It is also important for scientists from different organizations to work together towards a common project. It may be helpful for some organization, perhaps the Science Advisory Board, to sponsor events to build community and enhance networks among scientists at EPA. Workshops on cross-cutting topics might bring scientists together in new ways.

"Individual development plans" are a tool for strengthening science integration. Managers can ask staff about their fundamental interests and discuss how they can leverage that interest in new areas and new capabilities. EPA gets "incredible dividends" from guiding and investing in its scientific staff and broadening their perspectives.

Similarly, managers should listen to staff and check their assumptions about interactions with members of the public. EPA staff may benefit from training or coaching on how to interact with citizens on environmental science issues.

Participants discussed impediments to science integration:

- EPA staff and managers often say that "statutes don't give us the flexibility to use good science," but often regulations and statutes have more flexibility than they generally assume.
- IRIS database still contains outdated 10-year old pesticide risk assessments. OPP has asked ORD to remove these assessments, but it has not been done.
- Sometimes science integration seems easier across countries than within EPA.
- Sometimes it takes a while for EPA staff to fully understand new mandates and related science integration. As understanding evolves science integration within and across programs can develop.
- Many EPA programs focus narrowly on their own objectives and sometimes parochial interests; integration will require leadership from the top and an expectation that science integration will happen. Leaders at the top need to consistently give the message that science integration is important.
- Sometimes EPA lacks a forum for working through fundamental disagreements that are barriers for science integration. An example involves the differences between OPP, the Fish and Wildlife Service (FWS), and the National Marine Fisheries Service (NMFS) on ecological risk assessment. There has been no forum for these agencies to agree on data requirements for ecological assessments. The agencies differ on how data are to be used and there is a need for a high level agreement that can guide interactions on specific assessments. EPA has a process that quantifies risks and identifies qualitative factors.

Other agencies have a similar process, but weave assumptions about protection of species into the analysis (an assumption that springs from their mission to protect species) in ways that are not transparent. Policy is entwined with FWS and NMFS risk assessments in ways that make them inconsistent with OPP assessments and difficult for OPP to use.

- Lack of investment in social science (decision theory, cultural anthropology, and sociology) that will help EPA and the regulated public understand how to better communicate with each other concerning all the different regulatory programs working at different scales.

EPA Office of Solid Waste and Emergency Response (OSWER) Science Integration for Decision Making Fact-Finding Interview with OSWER Principal Deputy Assistant Administrator
December 1, 2009
Washington, DC

Three members of the SAB Committee on Science Integration for Decision Making interviewed the Principal Deputy Assistant Administrator of OSWER's: Drs. John Balbus and James Johnson in person and Dr. Penny Fenner-Crisp by telephone. Dr. Vanessa Vu, Director of the SAB Staff Office, provided a brief introduction to the purpose of the interview. She noted that the purpose of the interview was to help SAB Committee members learn about OSWER's current and recent experience with science integration supporting EPA decision making so that the SAB can develop advice to support and/or strengthen Agency science integration efforts. Dr. Vu thanked Mr. Breen for taking time for the interviews.

Dr. Angela Nugent, Designated Federal Office for the committee, took notes to develop a summary of the conversation. Mr. Breen was provided a copy of the committee's Preliminary Study Plan in advance.

Interview with OSWER Principal Deputy Assistant Administrator
Mr. Barry Breen

The committee members asked Mr. Breen to describe how he viewed science fitting into the overall activities of his office and his decision making and the drivers and barriers to science integration.

Mr. Breen responded that OSWER is a "huge consumer of science" and may be distinctive because decisions pertain both to national rules and guidance and site-specific decisions. For site-specific decisions, time is critical. EPA must make decisions about drilling wells, moving earth, short and long-term cleanups. The current science is critical to the decision. If important science is emerging, however, EPA cannot wait. The Integrated Risk Information System (IRIS) is very important and OSWER is "pushing to get files into IRIS." Where IRIS values don't exist, OSWER uses ORD provisional peer review toxicity values. ORD has guidance describing a hierarchy for using toxicity values. He asked the OSWER science advisor, Dr. William Sette, to provide the committee with this guidance.

Site-specific clean-ups offer the opportunity for public comment. EPA receives some scientific input as part of this public comment.

Mr. Breen noted that regions play a big role in OSWER programs. There are approximately 600 OSWER staff at Headquarters and 3,000 staff in the regions.

In response to an SAB member's question about how OSWER evaluates the use of science, Mr. Breen responded that there is no formal system. Similar to OSWER evaluation of its use of legal advice, managers have a sense of "how well the science supporting decisions was received" or "how well the science supporting decisions was accepted."

SAB members asked about barriers to using the best science. Mr. Johnson responded that OSWER depends on the National Contingency Plan, which sets up rules about the use of science and defines categories of scientific values as applicable or relevant and appropriate. Following those rules, a Drinking Water Advisory is in the "to be considered" category, while use of a Maximum Contaminant Level is mandated. Where OSWER cannot identify values, it must search for values and decisions are delayed.

In general, the Superfund program tries to use inputs from other organizations (e.g., Office of Water, Office of Research and Development, Minimal Risk Levels (MRLs) for Hazardous Substancesgenerated by the Agency for Toxic Substances and Disease Registry) and tries not to generate its own scientific values. One example of OSWER generating science is OSWER's support of ORD toxicity studies on Libby amphibole asbestos.

An SAB member asked about OSWER's efforts to address cumulative exposure and mixtures, in light of emerging science and National Research Council reports. Mr. Breen responded that the National Contingency Plan, developed in the 1990's, has guidance on how to address cumulative exposure and mixtures. In his view, the plan has "lots of texture," which allows EPA to acknowledge that sites have more than one contaminant. The plan calls for setting a preliminary remediation goal that will meet the most stringent of applicable values. The plan also allows EPA to go further in light of interactions. In his view, emerging science can be accommodated by the plan. The OSWER science advisor also noted that OSWER has guidance on aggregating exposures, using a hazard index approach for combining risk across pathways. Mr. Breen noted that some assessments include considerations of the exposed population's diet and background exposures.

Mr. Breen acknowledged that most OSWER decisions depend on health risk information, rather than ecological assessment information.

SAB members asked about the nature of OSWER's engagement of stakeholders and the public in site-clean-up efforts. Mr. Breen responded that community involvement coordinators are part of the standard case team at National Priority Locations. EPA "aspires" to the goal of seeking information about community members' priorities at every site, but he was "not aware of how successful such efforts have been."

SAB members then asked whether OSWER has all the support needed for science integration. Mr. Breen noted that the OSWER's Assistant Administrator can draw on a team of two scientists and can rely on the Office of Research and Development for help. He noted that OSWER conducts annual meetings for managers and members of case teams. Science is an important part of each meeting. Despite limited budgets for training, the Clu-in program provides an important resource for personnel at Headquarters and in the regions.
\

EPA Office of Solid Waste and Emergency Response (OSWER) Office of Resource Conservation and Recovery (ORCR) Science Integration for Decision Making Fact-Finding Interviews
November 24, 2009
Washington, DC

Three members of the SAB Committee on Science Integration for Decision Making interviewed the Chief and Staff of ORCR's Economics and Risk Analysis Staff and the OCRC Director: Drs. James Bus and James Johnson in person and Dr. Catherine Kling by telephone. Dr. Angela Nugent, Designated Federal Office for the committee, provided a brief introduction to the purpose of the interview. She also took notes to develop a summary of the conversation. All interviewees were provided a copy of the committee's Preliminary Study Plan in advance.

Dr. Nugent noted in each interview that the purpose of the interview was to help SAB Committee members learn about ORCR's current and recent experience with science integration supporting EPA decision making so that the SAB can develop advice to support and/or strengthen Agency science integration efforts. Dr. Nugent thanked participants for taking time for the interviews.

Interview with the Economics and Risk Analysis Staff

Participants:
Dr. Lee Hofmann, Chief, Economics and Risk Analysis Staff
Mr. Lyn Luben, Chief Economist, Economics and Risk Analysis Staff
Ms. Becky Cuthbertson, Risk Assessor, Economics and Risk Analysis Staff

Staff members began the discussion by describing how science integration happens, given their job function, and how science is integrated into decisions. One member noted the strong presence of risk assessment and economic considerations in regulatory activity; science was less of a factor for ORCR's non-regulatory activities. Staff noted that science is important to convince the public of the benefits of EPA actions and then noted that science is only one factor among many that influence EPA's decisions. Political, legal, and environmental justice considerations also play a role. Program staff who write regulations lead inter-disciplinary work groups and typically manage the decision making process from beginning to end, They consider Economics and Risk Analysis Staff 's input, other scientific input (including input on waste characterization, chemical analysis, and engineering), in addition to political factors.

The economic analysis builds on a multi-disciplinary base. Economists use information on engineering options, human health and ecological risk, and costs to generate a social cost and benefit analysis.

Time pressures, limitations of data, and budget limitations are the principal factors that prevent scientists from fully integrating the science and following some of the valuable recommendations in SAB and National Research Council reports. Often there are "false negatives" generated by the science, but it is difficult to address them effectively when a program must be implemented or a decision made. Stakeholders sometimes provide data that

lead decisions to change in major ways. Politics also comes into play and "that changes everything."

To address science issues, the staff typically uses in-house expertise or relies on contractors. At times, the Office of Research and Development provides expertise, but ORD assists fairly rarely, because ORD often cannot meet immediate short-term needs for science. OSWER participates in ORD's planning efforts, but staff felt that ORD often does not fill science gaps important to OSWER and called for more dialogue between OSWER staff and ORD lab directors and ORD's national program manager. Sometimes ORD's research initiatives can be modified in minor ways to increase their usefulness for OSWER programs. One interviewee noted the limited funding available for ORD's "land budget" to fund research. An area of immediate importance is investment in science underlying ecological benefits. Staff welcomed ORD's investment in research on ecological services, even if such research is focused on long-term outputs. ORD also provides input on OSWER regulations through EPA's work group process. There is, however, no formal measure of how much ORCR decisions are affected by ORD research or measures of how much ORD research affects decision making.

Another topic was lessons learned from evaluations of past use of science. One staff member noted that the pesticide program has compared the cost of cancelling pesticides against EPA's assessment of cancellation costs. EPA has routinely found that it overestimated impacts and has learned from that evaluation. ORCR conducts evaluations more informally. He predicted that lifecycle analysis will play an increasingly large role in EPA analyses and called for "fuller input /output cost/benefit life-cycle analysis" to be placed on EPA research agenda.

Interviewees then discussed how they "drive science forward" within their group at EPA. Staff noted that there is an Agency-wide economic forum, which allows economists to share information, learn about best practices and work together to address policy needs and gaps. The Economics and Risk Analysis Staff also sometimes uses a contract mechanism to fund white papers on important science policy issue. The OSWER science panel could then hold a symposium focused on that issue. OSWER used such an approach to address nano-technology lifecycle analysis issues. In addition, staff interact with international groups of solid-waste officials through the Organization of Economic Cooperation and Development and with state solid-waste officials and risk assessors. Economists have recently communicated more actively with their counterparts in the regulated communities.

The discussion turned to uncertainty analysis and the characterization and communication of uncertainty. Interviewees responded that they conduct uncertainty analyses and present information in ranges, rather than point estimates. They conduct probabilistic risk assessments, sometimes with very sophisticated models that use realistic information for key parameters (such as rainfall and hydrogeologic conditions) to generate "real-world" assessments. Sometimes, however, it is difficult to communicate uncertainty information for regulatory decisions. Scientists are "stymied" when they try to follow up on SAB and NRC recommendations regarding uncertainty. In one case, a member of the Economics and Risk Analysis Staff developed an analysis based on a "little PC-based model, with a nice uncertainty description." When she tried to communicate the uncertainty concisely in a Federal Register notice, the "Branch Chief decided that the language made it look like EPA didn't have a firm grasp of the

number and chopped it out." Scientists get "similar feedback from the lawyers," who say "you can't set us up for losing a lawsuit in the future." Even when results of an uncertainty analysis are published, the media often ignores the uncertainty. The media ignores the range and focuses on the point estimate--the upper end and median. It is very difficult to communicate accurate risk information in understandable ways. Interviewees noted that EPA managers differ in their interest in risk issues. Some are not willing to focus on the issues; other managers "really engage," and some engage too much and get lost in the details.

The interview then turned to the challenge of maintaining the "right discipline mix" among scientists as EPA faces a wave of retirements. This topic is a focus of management concern. Interviewees noted that sharing and team work helps the Economics and Risk Analysis Staff be effective. The Economics and Risk Analysis Staff has some of the core staff needed (hydrogeologist, engineers, soil scientists, economists, and risk assessors). They fill other critical needs (e.g., for a toxicology review) with contract support."

Interview with ORCR Director
Dr. Matthew Hale

Dr. Hale began the discussion by describing ORCR as both a "science-based institution and a legal-based institution," especially on the regulatory side. Science plays an important role but his office doesn't address pure science issues. Although the Resource Conservation and Recovery Act is not a cost-benefit statute, the office "looks at risk" for significant regulations, because EPA's mission is to protect human health and the environment, and the office looks at cost to help choose among options. Cost-benefit analysis is often a surrogate for choosing among smart, practical options.

Timing is a "perpetual challenge" for science integration. At the early stage of decision making, Dr. Hale seeks risk and economic analyses to help frame a problem and identify basic options. ORCR tries to have "enough information up front to make sensible decisions" but tries not to let the analysis become the focus of the activity. The priorities for his office are "laid out by statute" and have largely not been "of our choosing." With limited resources, he must consider how to get funds to address new emerging areas. In this context, ORCR uses "hard risk assessment science to deal with what's on our plate, as opposed to identifying emerging new chemicals." He is looking at the science underlying materials management and materials-flow analysis as areas where ORCR is most forward looking. For that science, he turns to the World Resources Institute and the Sustainability Consortium's sustainability initiative, a joint effort among 10 leading universities, European Scientists, with ORD input. He is looking for opportunities to encourage sustainable products and activities as a program direction.

SAB members asked Dr. Hale to discuss how he deals with uncertainties. He responded that research on most issues identifies anomalies, not more surety. In his view, when a decision needs to be made, "you have to stop and make a call." If EPA needs a risk assessment number for a listing decision and EPA doesn't have one, "we'll pick a number that California used." He noted the value of combining risk assessors and economists in ORCR's Economics and Risk Analysis Staff. For his office, he "likes to think science is part of everyone's skill sets." He expects staff to know the issues and know the related science and scientific uncertainties.

In response to an SAB member's question about processes to help improve the use of science over time, Dr. Hale responded that feedback comes in three ways. The public provides feedback. Peer review is a good way to get feedback. And if something hasn't worked internally, he hears and listens to complaints. To foster science integration, the office encourages team approaches and expects scientists to build and maintain networks related to their work.

The discussion concluded with a brief discussion of communicating science and risk. Dr. Hale noted that often the key issue is whether EPA has "the legal minimum to sustain challenge." Whenever EPA communicates, it is very important to write or speak clearly in a "straightforward manner" and not get trapped in jargon. There is a need for good communications people at EPA who can help translate information for different audiences. There's a need for better writers, more communications support, and training for EPA staff, who, very often, think they don't need training.

Office of Solid Waste and Emergency Response (OSWER) Office of Superfund Remediation and Technology Innovation (OSRTI) Science Integration for Decision Making Fact-Finding Interviews
November 24, 2009
Washington, DC

Four members of the SAB Committee on Science Integration for Decision Making interviewed the Deputy Director of the OSWER's OSRTI: Drs. James Bus and James Johnson in person and Drs. Catherine Kling and Thomas Theis by telephone. Following that meeting, the SAB committee members interviewed the Associate Director of OSRTI's Technology Innovation and Field Services Division. For each interview, Dr. Angela Nugent, Designated Federal Office for the committee, provided a brief introduction to the purpose of the interview. She also took notes to develop a summary of the conversation. All interviewees were provided a copy of the committee's Preliminary Study Plan in advance.

Dr. Nugent noted in each interview that the purpose of the interview was to help SAB Committee members learn about OSRTI 's current and recent experience with science integration supporting EPA decision making so that the SAB can develop advice to support and/or strengthen Agency science integration efforts. Dr. Nugent thanked participants for taking time for the interviews.

Interview with OSRTI Deputy Director
Mr. Barnes Johnson

The committee members asked Mr. Johnson to describe how he viewed science fitting into the overall activities of his office and his decision making. Mr. Johnson responded that the Superfund Remedial Program made use of the most complex science for the most complex environmental problems. The Superfund Removal Program was more "surgical" - EPA "gets in and gets out."

The remedial program, also referred to as the "abandoned waste site program," focuses on longer-term clean-up of hazardous waste. Science and technical issues touch all aspects of the program. There is a long "purposeful process" involving the following steps:

- site assessment, which involves taking samples, laboratory analyses to determine the nature and extent of contamination, and monitoring. EPA must choose sampling strategies, deal with uncertainties, develop chemical methods, and summarize information in ways people can understand.
- if EPA determines sites are worthy of cleanup, EPA conducts more intensive assessment that involves development of conceptual site models, modeling addressing multiple factors (e.g., geotechnical, hydraulics, subsurface water analysis) and using very detailed information.
- EPA then considers alternatives. The Superfund program employs nine criteria; nearly all (seven of the nine) involves social science. Evaluation of alternatives by criteria involves intensive consideration of scientific and technical issues. EPA conducts feasibility studies using the nine criteria to select among alternative.s
- EPA designs chosen options.

- The option is implemented

SAB members followed up with several questions. A member asked how staff stay informed about the huge body of external scientific activity relevant to remediation. Mr. Johnson responded that his office contained a division focused on technology innovation. Personnel identify and evaluate emerging technologies for addressing contaminants. The division has kept informed as technologies have evolved. The division looks at a wide range of innovative technologies, e.g., soil vapor extraction process, zero valent ion, subsurface walling systems, redox chemistry to mitigate contamination, bio remediation, in situ chemical oxidation. The division has a technology trends newsletter (sent to 25,000 people monthly), which receives a high level of user community feedback. The division maintains a Web site devoted to technological innovation forums (www.cluin.org) and provides "pretty elaborate training programs" in which EPA trains "thousands and thousands" of individuals in innovative technologies every year. EPA sponsors and participates in conferences. Staff are involved in "all sorts of networking" and participates in a Federal Facilities Technology Roundtable.

The division funds innovative technologies through a program that encourage people to take risks and try promising new technologies whose efficacy and speed are uncertain. His office asks regions to identify sites where innovative technologies could be considered. OSWER underwrites the clean-up. If the innovative remedy goes wrong, remedial clean-up is guaranteed and backed up by conventional approaches. The office publishes an annual report on new and emerging science. The reports provide a perspective on how previously innovative technologies become accepted.

In response to an SAB question, Mr. Barnes stated that site clean-up involves evaluation of economics and community acceptance, in addition to efficacy of technology.

Mr. Johnson then discussed the sources of science used in the Superfund program. The office interacts with the National Institute of Environmental Health Science (NIEHS) on biology and health science issues through the Superfund Basic Research Program. The Superfund Science Policy Branch chief provides a liaison with NIEHS.

Mr. Johnson commented on impediments to introducing new science. One barrier for his program is shared across all EPA and involves evaluating latest toxicology information for high profile contaminants important to certain constituency groups where there are big financial implications. Examples are trichloroethylene, dioxin, and perclorethylene. In such cases, the "science review is used to create long-term do-loops that keep us from getting the latest information implemented in the field." This dynamic delays the Integrated Risk Information System (IRIS) review process. Office of Management and Budget review and inter-agency review can present real obstacles. Peer review *per se* is not the obstacle -- some of these chemicals "couldn't be more peer-reviewed." Strong stakeholder opposition is really the issue. Arguments about how to interpret the available science are perpetuated to keep new science from being implemented.

An SAB member asked about how EPA could address the problem of using uncertainties in the science to delay environmental clean ups. Mr. Johnson responded that EPA has received

advice from the SAB and other groups about how to reflect uncertainties in risk assessments. EPA still struggles in general to bring uncertainty into risk assessments. Often EPA does not have the luxury of analyzing five or more studies that meet all the guideline criteria so there can be a collective characterization of uncertainties. More often, EPA has a couple of studies and one seems clearly superior. His office relies on other parts of EPA to provide toxicity assessments. Where that information is not available, his office evaluates assessments from the State of California's toxicology program or from the Agency for Toxic Substances and Disease Registry. His program scientists "look across the literature and pick what they think is the most appropriate characterization of evidence and go with that. They typically pick a driving study, using a weight of evidence approach and describe the confidence qualitatively." They usually use a model that generates a single number.

An SAB member asked whether Mr. Johnson has reviewed recommendations in the NRC *Science and Decisions* report and considered whether OSWER's approach could be improved with the report's recommendations. Mr. Johnson noted that he had not considered those recommendations.

Mr. Johnson noted that his technical staff is able to conduct many highly complex analyses, integrating detailed geological, hydrological, and toxicity data. In some cases, however, where a Principal Responsible Party might hire a modeler to perform a complex assessment, OSRTI might hire a contractor to evaluate that assessment

SAB members asked Mr. Johnson to comment on how his office works with communities and presents scientific information. They asked how OSRTI communicates alternatives and whether community input feeds into targets and options. They asked whether such activities involve behavioral and social scientists. Mr. Johnson responded that OSWER's new leadership is very committed to community engagement and involvement and very interested in risk communication. In OSRTI, there is a "whole area of practice" involving a national group of community involvement coordinators, whose precepts are to talk with communities as early as you can, as much as you can, and to be as open as you can. The group has been successful to various degrees.

Superfund authorizes OSRTI to award Technical Assistance Grants (TAG) so that technical experts can help communities digest the avalanche of technical information generated at every step of the Superfund process. He noted that it was very important to select TAG recipients that can really translate information and noted that "some of them do it well and some don't." SAB members asked how OSRTI evaluates the effectiveness of TAG activities. Mr. Johnson respondent that OSRTI staff Bruce Englebert recently published an article in the *Journal of Environmental Managemen*t evaluating the effectiveness of community involvement programs. The article summarized the results of a formal survey, approved by OMB, of five or six clean-up sites. The survey format and sampling strategy reflected rigorous and systematic work. It would be too resource intensive to conduct such surveys for every community involvement effort, but the study is a guidepost for future evaluation efforts. OSRTI is considering the use of social media tools to provide more real-time feedback in a less costly manner. He noted that OSRTI has used a wide range of community involvement mechanisms,

including hearings and workshops with booths staffed by experts so people could talk with specialists about different technical aspects of site clean up.

SAB members asked how OSRTI staff kept current with changing technology. Mr. Johnson responded that, in addition to attending professional meetings, workshops, and conferences, each OSRTI expert has an "elaborate network of practice." One example is the TRIAD, a monitoring network that has a web presence that welcomes all comers. New information is posted frequently, with information about conferences, internet sources, webinars, and remote training. He noted that OSRTI has been "ahead of the curve" regarding technology transfer. It has sustained a high level of performance and is now exploring social media and new technologies for information sharing.

Interview with the Assistant Director of the Technology Innovation and Field Services Division, Science Policy Branch Chief and Staff

Participants:
Dr. Helen Dawson, Chief, Science Policy Branch
Mr. Jeff Heimerman, Assistant Director, Technology Innovation and Field Services Division
Mr. Matthew Chawry, Science Policy Branch
Mr. Steven Chang, Science Policy Branch

The conversation began with a discussion of the work of the Technology Innovation and Field Services Division. The challenge for the division is to support OSTRI's need for "distributed decision making for land clean-up." Management decisions must continually rely on available science, where there is uncertainty because of the current state of scientific tools, knowledge, and science integration. The division has 70 people. It provides site-specific technical assistance in many ways. It manages a contract that analyzes 145,000 samples per year that are blind to the site, which meet Quality Assurance requirements, and feed analytical information to decision makers at the regional level. The division is responsible for the statements of work that set analytical standards for these analyses and conducts an audit program that guarantees the quality of the program. The division also has responsibility for training and knowledge transfer related to advanced technology, policy, and procedures for emergency response.

The chief of the Science Policy Branch then described her branch's efforts to keep abreast of the latest science. Individual staff members go to national science meetings (not just EPA meetings) and conferences. They look for opportunities to use the information to inform decisions about site remediation and assessing risks at sites. Members of her branch lead technical work groups to address key science issues relevant to OSTRI. The work groups include regional scientists, ORD representatives, and state scientists. The Science Policy Branch sends major work products to these workgroups for feedback. One example is the action plan to address Libby amphibole asbestos. Another example is the use of risk assessment modeling for lead risk assessment, one chemical for which the Branch uses modeling of blood levels estimated from soil concentrations rather than monitoring of blood levels to determine risk assessment levels. The goal is to use the best science to address issues that have a national impact.

Work products generated by the Science Policy Branch typically receive external peer review by experts identified by an independent contractor. In some cases, work products receive SAB review. The SAB asbestos review prompted OSWER to "go back to the drawing board to re-evaluate." The branch has discussed not only how to strengthen that analysis, but also how to improve the workgroup process for developing future technical documents.

An SAB member asked how the branch handled the connection between science and policy. The Science Policy Branch Chief responded that, once assessments are completed, her staff works with regions to identify acceptable, implementable policies. The Science Policy Branch then works through EPA's Action Development Process with an Agency workgroup that includes representatives of different program offices impacted by a proposed policy. The workgroup develops options, which they discuss with the lead Assistant Administrator, then other Assistant Administrators. The policy is then sent to OMB and other federal agencies for review

The process for stakeholder input primarily involves informing stakeholders about the schedule for developing a new policy (one example was internet posting of the schedule for developing a new policy on dioxin) and taking formal public comment on the policy. The Branch Chief noted that OMB doesn't like a draft document to be released for public comment until OMB review has concluded. Sometimes OMB review "trumps" the science in formation of a policy. While OMB has "stymied development of some products" and review is influenced by the political tone of the day, nevertheless, the inter-agency process provides input that strengthens science products

The discussion then turned to the role of science input from ORD for OSTRI decision making. The Technology Innovation and Field Services Division does not generally consider ORD as a "technology development machine" for site clean-up. Instead that division looks at a broader marketplace for ideas and technology. The division looks for opportunities to take advantage of the huge investments made by the Department of Defense, Department of Energy, National Aeronautics and Space Administration, and National Science Foundation, especially from a demonstration validation perspective. The Science Policy Branch chief noted that ORD is responsive if OSWER provides funding for a specific toxicity study. One example is OSWER funding for in vivo and in vitro asbestos toxicity studies. ORD's National Health Effects Research Laboratory "stepped up to the plate" and devoted ten scientists to that effort. The OSTRI managers noted that their priorities often don't get attention as part of ORD's land research program. OSTRI, as a result, seeks other partners. They have cooperative agreements with Argonne National Laboratory and the Army Corps of Engineers. The Technology Innovation and Field Services Division hosts a federal remediation technology roundtable that identifies and explores cutting-edge technologies and issues (e.g., vapor intrusion). Interviewees noted that there is not always a match between OSTRI's needs and ORD's interest, enthusiasms, and activities.

Both managers spoke of the importance of staff keeping abreast of the latest science, being the "eyes and ears" of the organization, acting like "beat reporters" following scientific and technical issues. They spoke of the value of the OSTRI's "Clu-in" Web site as a "go-to source" for technical information.

In response to an interview question, managers reflected on the usefulness of recent SAB and National Academy of Sciences reports. The Science Policy Branch Chief noted that it is useful to highlight the boundaries of science investigations and be conscious about how they affect decisions. She also noted the value of a recommendation in the recent *Science and Decision* report, which "hit the key issue of revisiting default assumptions to see if they are based on inertia or best information."

The group then briefly addressed the issue of uncertainty. In particular reviews (e.g., for the lead risk assessment) Science Policy Staff can evaluate existing literature and reevaluate assumptions. It is more difficult to address the issues of default parameters for risk assessment generally. One scientist spoke of the many uncertainties associated with groundwater, despite surveying the available information from Technology Innovation and Field Services Division, Office of Water, and Association of State and Territorial Solid Waste Management Officials. In some cases, OSTRI staff "don't know how to clean up some of this stuff" and can only manage to "stop it from spreading. Other staff noted that Clu-in and the efforts of the Technology Innovation and Field Services Division gave them confidence that they are using the state of the art.

SAB Science Integration for Decision Making Fact-Finding Meeting
Office of Water, Office of Ground Water and Drinking Water (OGWDW)
EPA West, Washington, DC
January 20, 2010

Four members of the SAB Committee on Science Integration for Decision Making conducted two interviews in EPA's Office of Ground Water and Drinking Water (OGWDW): Drs. James Johnson and Gary Sayler in person, and Drs. Wayne Landis and Thomas Theis by telephone. Dr. Vanessa Vu, Director of the SAB Staff Office, provided a brief introduction to the purpose of the interview and the Designated Federal Officer, Dr. Angela Nugent, took notes to develop a summary of the conversation. All interviewees were provided a copy of the committee's Preliminary Study Plan in advance.

Dr. Vu noted in each interview that the purpose of the interview was to help SAB Committee members learn about OGWDW's current and recent experience with science integration supporting EPA decision making so that the SAB can develop advice to support and/or strengthen Agency science integration efforts. Dr. Vu thanked participants for taking time for the interviews and thanked Mr. Thomas Carpenter for coordinating with the SAB Staff Office in planning the meetings.

Meeting with the Office of Water, OGWDW Office Director and Director, Standards and Risk Management Division (12:45 p.m. - 2:00 p.m.) Participants:

Ms. Cynthia Dougherty, Director, Office of Ground Water and Drinking Water
Ms. Pamela Barr, Director, Standards and Risk Management Division

OGWDW relies on many different kinds of science, e.g., health science, economic analyses of costs and benefits, and engineering, to do its primary job, implementing the Safe Drinking Water Act (SDWA). The Office Director recommended that one of the conclusions of the SAB's science integration study be that "OGWDW relies almost solely on the Office of Research and Development (ORD) to develop health effects research needed to do our job." SDWA specifically requires that decisions be made on the best available science. The legal test is the "best available" science, not "perfect science," and courts have interpreted this language strictly. For example, EPA was sued and lost in court over a chloroform Maximum Contaminant Level Goal (MCLG) where the court found that EPA had set an MCLG but had not used a published study showing a threshold for chloroform effects.

Because of its legal mandate, OGWDW continually identifies science questions related to decision making, evaluates the best available science, explains EPA's decisions in light of the best available science, and identifies the science needed for the future. OGWDW is involved in different kinds of decisions where science is involved: Principal decisions include:

- whether to include chemicals on the Chemical Contaminant List (CCL),
- whether to monitor unregulated contaminants,
- whether to regulate chemicals on the CCL (if the chemical has adverse effects on the health of persons, occur in water systems, and if there meaningful opportunity for health risk reduction if EPA decides to regulate).

- Where to set MCLGs and Maximum Contaminant Levels (an enforceable and measurable goals, based on the feasible protective level that systems can achieve).

Scientific assessments help OGWDW decide when to take different kinds of action to regulate chemicals. Different kinds of decisions may be supported by different kinds of science (e.g., the science needed to list a chemical on the CCL may differ from the science needed to set a MCL; formal benefit-cost analyses are required to support rulemakings). Where science is not strong enough to take action, OGWDW makes an explicit decision to get stronger science to support future decisions. OGWDW described areas of scientific uncertainty relating to decisions in several areas:

- Risk assessments for chemicals not yet complete or uncertainties associated with available risk assessments [OGWDW generally looks to IRIS numbers, pesticide assessments, ATSDR, or numbers generated by OW's Office of Science and Technology (OST)].
- Lack of nationally representative occurrence data and how to characterize the representativeness of available regional data. This information feeds into exposure analyses used for benefit-cost analyses.
- Robust monitoring methods that can be used by drinking water treatment facilities.
- Benefits cannot be characterized in some cases in monetized ways, as supported by available science. In the case of the arsenic analysis, for example, EPA was able to monetize bladder cancer effects, but not non-cancer effects, such as high blood pressure.

OGWDW uses many different processes to integrate science.

- Sometimes the public has pointed to new bodies of knowledge. In the case of the microbial disinfectant byproducts rule, the first advisory committee consulted by OGWDW recommended that EPA conduct more monitoring. EPA and the industry invested over $100 million in monitoring and data gathering on treatment technology and disinfectant byproducts. A large external group helped OGWDW interpret the data and reached that conclusion that different parts of that country varied widely in the kind and levels of disinfectant byproducts. As a result, OGWDW considered different regulatory options than initially envisioned.
- The Administrative Procedures Act provides opportunities for public comment on Agency rulemakings.
- OGWDW sought external science advice from multiple advisory committees on the CCL: from the National Research Council (NRC), National Drinking Water Advisory Committee (NDWAC), and the SAB's Drinking Water Committee.
    - For the third CCL, OGWDW obtained expert input at key decision points to identify a universe of 7,500 drinking water contaminants then screen this universe to a preliminary CCL 3 of almost 600 contaminants that warranted further evaluated and then select 116 contaminants for the final CCL 3.
- For the 2001 review of the arsenic rulemaking, OGWDW brought different aspects of the problem to different advisory groups and managed the process so that EPA received advice from each group within 6 months.
    - The NRC provided advice on health assessments
    - The SAB provided advice on benefit assessment and related uncertainty
    - The NDWAC provided advice on costs

OGWDW noted the importance of planning carefully where it brings issues to different advisory committees and how to frame charge questions carefully to get the advice and review needed to make sure that the science supports our decisions.

OGWDW has a team devoted to identifying research needs to support its activities. The group coordinates with ORD on EPA Drinking Water Research Program, including the STAR grant program, and also with other research organizations, such as the Water Research Foundation. In collaboration with OST, OGWDW keeps informed about research conducted by the World Health Organization, Dutch Water Research Foundation, and with other international organizations.

Barriers to science integration include:

- Limitations of regulations: SDWA doesn't give EPA regulatory authority over source water, but safe drinking water often depends on quality of source water and treatment needed to provide drinking water
- Sometimes regulatory time constraints make it difficult to address all NRC, SAB, or NDWAC recommendations
- Lack of flexibility in ORD research plans and researchers' willingness to shift resources to priority OGWDW program needs
- Lack of effective communication about the execution and status of ongoing drinking water research. Can be often difficult to know which research projects are actually underway and on track to support decision-making.
- Potential concern that ORD's multi-disciplinary research initiative may shift resources away from the well-identified research needs of the Drinking Water Research Program.

OGWDW has made limited use of social science other than economics. It has recently worked on message mapping to help with risk communication in the area of water security. The process involved "laying out questions from the public" and identifying responses at different levels of complexity. The process worked well but was difficult and time consuming. It trained OGWDW in communicating more effectively and may be useful for underground injection issues. Although OGWDW has some expertise in communication, not all communicators are adequately trained. This issue will become more important as OGWDW reaches out increasingly to stakeholders outside NDWAC, especially to people in environmental justice communities who may be less informed and engaged in drinking water issues. The OGWDW Director noted the value of accessing expertise through post-doctoral fellows with training in communication and social science.

Meeting with the Office of Water, OGWDW Managers and Scientific Staff (2:15 p.m. - 3:30 p.m.) Participants:

Eric Burneson, Chief, Target Analysis Branch
Jeanne Briskin, Chief, Standards and Risk Reduction Branch
Stig Regli, Policy Advisor, Standards and Risk Management Division

The managers started the discussion by describing the decisions their branches participate in and how science is integrated into those decisions. The Standards and Risk Reduction Branch

evaluates scientific and technical data to support decisions related to pathogens, disinfection and disinfection byproducts. The branch has experts from multiple disciplines, including chemistry, microbiology, statistics, economics, engineering, and policy analysis. The branch works with OST and ORD to monitor current science related to the potential occurrence and health effects of pathogens and disinfection by-products. The branch works with the decision rules provided by SDWA to determine prudent, science-based approaches and engages the NDWAC, SAB, and other advisory committees to get input from stakeholders and scientists on science assessments. One recent example of this process is the revised total coliform rule, where OGWDW held open public meetings, including collaboration through a Federal Advisory Committee (FAC) and consulted with the SAB.

Science assessments for decision making often involve integration of complex science and multiple uncertainties. Sometimes OGWDW does not have monitoring information on pathogens in distributed water and must use models to estimate occurrence of pathogens in distributed water, given different source water treatment technologies. Analyses based on this information inform default assumptions used to set the National Primary Drinking Water Regulations (NPDWRs). There are many "grey areas" with important uncertainties. Another important uncertainty relates to risk/risk tradeoffs, unintended consequences of controlling for pathogens that introduce byproducts with potential adverse effects. OGWDW must often conduct "simultaneous" risk assessments, because issues are so complicated. In these cases, it is very useful to have to have different external perspectives inform the assessment and decision process.

The Target Analysis Branch has responsibility for chemical contaminants beyond disinfection byproducts. Like the Standards and Risk Reduction Branch, the Target Analysis Branch is a multi-disciplinary team of economists, engineers, health scientists, and public policy experts. The statutory drivers for integrating science and policy are "quite clearly laid out in SDWA." For the CCL, OGWDW sought advice from the NAS, which provided three reports on prioritizing drinking water contaminants, and then asked for input from NDWAC, which provided stakeholder input for implementing the NAS recommendations and finally consulted with the SAB on how well EPA had carried out the NAS and NDWAC recommendation in preparing the CCL 3. EPA also sought input from the NDWAC on how to best make regulatory determinations for CCL contaminants. OGWDW also consults with the SAB when proposing Maximum Contaminant Levels Goals and national primary drinking water regulations. SAB input on rulemakings has been sought on issues including benefit-cost analyses. The risk management processes required under SDWA are iterative. SDWA requires EPA to review and evaluate national primary drinking water rules every six years to determine whether revisions of the rules are appropriate which will maintain or improve public health protection. Any proposed new or revised standards must at least maintain or improve public health protection and have a public comment process. EPA sometimes uses advisory meetings provide opportunities for stakeholder analysis for more significant rulemakings.

Participants agreed that different kinds of decisions required different thresholds for the science needed in terms of breadth, depth, and level of stakeholder involvement. For the CCL, for example, the release of a contaminant into the environment is a surrogate for presence of that

chemical in drinking water. For a regulation, in contrast, EPA provides measured national occurrence of that chemical in finished water. EPA must also assess adverse health effects. There is significant stakeholder involvement in CCL, regulatory determinations and development of NPDWRs. Public involvement intensifies as OGWDW involves Federal Advisory Committees. The greatest degree of stakeholder involvement has occurred through the special regulatory negotiation process for the microbial disinfectant byproducts rules.

Research planning to support OGWDW's need for integrated science is a priority. OGWDW has a dedicated research team that focuses on the research "big picture" -- the key regulatory drivers, research questions and time frames -- where OGWDW needs answers to make decisions. This effort has informed ORD's Drinking Water Multi-Year Plan and OGWDW's periodic visits to ORD laboratories, which allows an exchange of information and builds ORD's understanding of OW's research needs and OGWDW's understanding of the potential for ORD's research. OGWDW's research planning process has also informed OW's recent *Office of Water Research Strategy*, which has stimulated the work of the Water Research Foundation. OGWDW and ORD are both interested in low-dose issues and have "periodic dialogues" to coordinate analytical needs and efforts.

OGWDW has a strong desire to optimize research developed by ORD's research groups. For example, OGWDW's Water Security Division works closely with ORD. OW works with the National Homeland Security Research Center especially in modeling and monitoring of drinking water distribution programs. ORD has also completed a significant comprehensive assessment of microbial risk assessment.

Barriers to science integration include:

- Slow development of health assessments for some chemicals, like MTBE.
- Concern that ORD's Integrated Multidisciplinary Research Transformation may assign specific drinking water research needs a low priority.
- STAR grant projects (e.g., in the area of disinfection impacts on distribution systems) not always managed so that awards were made to projects with program relevancy. Sometimes it seems that technical peer review screens out relevant projects.
- Statutory deadlines that make it difficult to generate and assimilate all needed science
    - One example: the NAS recommendations to improve the CCL process were sweeping recommendations that EPA could not adopt within one year. EPA adopted many of the recommendations when developing CCL 3. The NDWAC recommended using an adaptive management approach to consider the remaining recommendations in future CCLs.

The work force appears to be nimble because OGWDW's work requires a multidisciplinary approach. For example, engineers have been required by assignments to acquire knowledge of public health and staff generally is expected to collaborate with other disciplines when they conduct an assessment. When OGWDW recruits new staff, it specifically looks for flexible individuals who can learn new information and work in teams. Promotions and career path are determined by analysts' contributions to the work of their division. Branches include staff working in social sciences, including economics and communications, but no psychologists or sociologists.

OGWDW invites regions to participate in rulemakings, the CCL, regulatory determination, and review of existing regulations. EPA also invites State Drinking Water Administrators to participate in the development of proposed rulemakings. When regions participate, they offer valuable practical experience. OGWDW also organizes a monthly call for regional drinking water branch chiefs. OGWDW views states as co-regulators and partners in environmental protection. State drinking water contacts participate in Agency work groups in the early development of rules up to the proposal stage. After that point, they become stakeholders and can comment on proposed rules through the formal notice and comment process.

SAB Science Integration for Decision Making Fact-Finding Meeting
Office of Water, Office of Science and Technology (OST)
EPA West, Washington, DC
January 28, 2010

Five members of the SAB Committee on Science Integration for Decision Making conducted two interviews in EPA's Office of Water (OW), Office of Science and Technology (OST): Drs. James Johnson and Gary Sayler in person, and Drs. Terry Daniel, Wayne Landis, and Thomas Theis by telephone. Dr. Vanessa Vu, Director of the SAB Staff Office, provided a brief introduction to the purpose of the interview and the Designated Federal Officer, Dr. Angela Nugent, took notes to develop a summary of the conversation. All interviewees were provided a copy of the committee's Preliminary Study Plan in advance.

Dr. Vu noted in each interview that the purpose of the interview was to help SAB Committee members learn about OST's current and recent experience with science integration supporting EPA decision making so that the SAB can develop advice to support and/or strengthen Agency science integration efforts. Dr. Vu thanked participants for taking time for the interviews.

Meeting with the Office of Water (OW), Office of Science and Technology (OST) Scientific Staff (January 28, 2010, 12:45 p.m. - 1:45 p.m.) Participants:

Ms. Lisa Huff, Team coordinator/Toxicologist
Ms. Mary Reiley, OW Research Coordinator
Ms. Amy Newman, Chief, Regional, Tribal and State Support Branch
Dr. Santhini Ramasamy, Toxicologist

The Office of Science and Technology has three divisions: a Health and Ecological Criteria Division (HECD), a Standards and Health Protection Division (SHPD), and an Engineering and Analysis Division (EAD). HECD develops human health criteria and health advisories to support drinking water regulations under the Safe Drinking Water Act (SDWA); these as well as ecological water quality criteria also support risk management actions under the Clean Water Act (CWA). Under CWA, criteria and advisories are published as guidance for States and Tribes to use in establishing their water quality standards. EPA's science-based ecological and human health CWA criteria are non-enforceable risk assessments. EPA has review and approval authority over the enforceable State and Tribal final standards. In consultation with HECD, SHPD responds to questions from EPA Regions, States and Tribes on the science or scientific defensibility of water quality criteria. Where there are complex science policy issues associated with implementation of water quality criteria, SHPD develops implementation guidance for States and Tribes in consultation with HECD. Examples of such issues are the fish tissue-based methylmercury criteria and criteria that use a biotic ligand model. The Engineering Analysis Division is responsible for effluent guidelines under CWA. An Economic Analysis Branch provides the division with support for guideline development.

To develop water quality criteria or guidance, HECD staff reviews available literature on effect, occurrence, and exposure; identifies needed information; works with ORD, the Office of

Pesticide Programs (OPP) and other Program Offices, and/or contractors to "fill holes" in the data set; and uses standard methodologies (which includes a "good science clause" that allows for use of nontraditional approaches such as the biotic ligand model) to develop draft documents. OST uses externally available data when the needed research involves standard toxicity testing, a task of low interest for ORD. OST may not have the ability to wait for generation of laboratory or epidemiologically based data if there are legislative or court-ordered deadlines for a regulation or other risk management action. Risk assessments under CWA and SDWA are based on best available science). OST seeks external peer review and scientific views from the public on draft documents. OST has sought advice from the SAB, for example, on interim steps involved in developing new criteria and approaches. OST works to integrate Agency Risk Assessment Forum guidelines, such as the *Ecological Risk Assessment Guidelines*, into its criteria work.

Development of a criteria document can be costly and ranges from $50,000 to $300,000, depending on the complexity of criteria, the amount of toxicity data available, and if additional testing is determined to be appropriate or necessary. For some situations, novel approaches are needed to derive criteria that reflect the unique water quality or biotic dynamics of the pollutant. For example, for two decades OST has been adjusting its criteria derivation approach to protecting aquatic life from the effects of metals. The most recent effort, the biotic ligand model for availability of metals to aquatic life began in 1993. Development has involved time-consuming "proof of principle research" and modeling.

SHPD develops implementation guidance based on traditional "hard sciences," not social or economic sciences. Under section 304(a) of the CWA, water quality criteria are based solely on data and scientific judgments on the relationship between pollutant concentrations and environmental and human health effects; water quality criteria do not consider economic or social impacts. In addition, the litigious nature of American society is a barrier to EPA's explicitly using social science in development of water quality criteria and implementation guidance, as the use of social science can give the impression that science has been diluted or influenced. One perspective is that if EPA analysis focuses on a bright line or range between two extremes, there can be some certainty that a level is protective.

SHPD does, however, consider social and economic science input in making specific decisions, when needed, related to State and Tribal water quality standards. While the CWA requires that States develop water quality criteria that are protective of the designated uses of waters, there are provisions of the Act and associated regulations that enable States to change the designated use of a water body if it can be a demonstrated that meeting the standard would result in substantial and widespread economic and social impact. Also, states are not required to adopt 304(a) recommended criteria; they have the option to develop their own water quality criteria. SHPD's Regional, Tribal and State Support Branch, in consultation with HECD, evaluates proposed water quality criteria generated by States and the supporting scientific justification. The key question is whether the proposed criteria are protective of the State's designated uses for waterbodies. If a state does not meet its responsibilities under CWA, EPA may develop water quality standards in their stead. For example OST is currently developing federal water quality standards for nutrients in the State of Florida.

OST sometimes collaborates with States and Tribes to develop aquatic life criteria. Prominent examples are collaborations with Region 7 on chlorides in Iowa, pesticide criteria for Minnosota, and selenium criteria in California. Many state- or site-specific issues arise in implementation of criteria. For example, the unique geography or ecosystems may have dry washes that host a wet aquatic community only during rainy seasons or wet weather events. Between events the area returns to its dry state and limited aquatic community support. OST works with the state or tribe to examine how much adjustment in either water quality or quantity the aquatic community can withstand and the economic and social aspects of the aquatic life valued by the human community.

OST is collaborating with OPP in stakeholder listening sessions that will help these Programs reach a common health and eco effects assessment for use in regulatory efforts to address toxics. The two offices are jointly preparing a white paper to be sent to the FIFRA Scientific Advisory Panel (SAP).

OST decides the degree of involvement of outside stakeholders and outside scientists based on its judgment of the likely impact of OST science. If OST believes that there will be a major impact, then the OST science or activity receives extra scrutiny, additional investment, additional peer review, and "extra scrubbing of proof of principle." In OST it is often said that if there is lively public interest --and critique -- from different sides of an issue, it generally means that OST got the science right. In some cases, OST has reexamined the science supporting a decision. In the case of tributyl tin, OST reopened its analysis and pulled in more data when the state-of-the-science used in the original derivation was determined to need updating. OST reevaluated the 1999 ammonia criteria because of new data indicating greater sensitivity of freshwater mussels. OST conducted an extensive peer review of the draft ammonia criteria update, which involved ORD, the U.S. Fish and Wildlife Services, U.S. Geological Survey and EPA Regions. In the case of atrazine, OST revised its criteria in light of emerging research funded by EPA on endocrine disruption as well as research funded by the regulatory community showing a lack of effects. OST has sought review from the SAP multiple times and is reevaluating studies because of issues raised by the panel. In general, the peer review process leads to more thoughtful documents.

Limited availability of scientists with the needed expertise is the chief impediment to science integration. EPA has the right expertise to support OST's programs but insufficient numbers of scientists with that expertise leaves them spread too thin. With limited number of scientists with the appropriate expertise available, OST turns to the same scientists in ORD for assistance for multiple and simultaneous efforts. Another impediment is the frequent controversy over water issues in the media; for instance, an article in the Associated Press can divert scientists and analysts from the project to responding to press and congressional inquiries leading to derailed or extended research plans.

To help the focus on science integration, OST staff focus on management priorities; monitor the needs of States, Tribes, and Regions for science support through regional Water Quality Standards Coordinators and through the Water Quality Standards Managers' monthly calls; participate in professional society meetings, and through state organizations (e.g., State FIFRA Issues Research and Evaluation Group and Association of State and Interstate Water

Pollution Control Administrators). OST also partners with research organizations to evaluate research proposals for relevance to water program needs; for example, the Water Environment Research Foundation, the National Academy of Sciences, and the Small Business and Innovative Research grants program,

OST has recently participated in an OW-wide effort to develop a *National Water Program Research Strategy* to identify priority research needs. OW canvassed the needs of all OW offices and Regional offices to identify research needs and related "drivers." The strategy identifies a hierarchy of research needs and identifies critical path research questions. The strategy defines four theme areas (Healthy Watersheds and Coastal Waters Research Needs; Safe Drinking Water Research Needs; Sustainable Water Infrastructure Research Needs; and Water Security Research Needs). Information about the strategy can be found on the web at: http://www.epa.gov/waterscience/strategy/. The strategy "cross-walks nicely" with ORD's multi-year plans, but it is aimed at a broader audience, i.e., other federal agencies, other funders of research, and external researchers whose work could contribute to meeting the research needs of the National Water Program. OW intends that the strategy will evolve into an electronic inventory of research related to the needs of the national water

Meeting with the Office of Water (OW), Office of Science and Technology (OST) Deputy Office Director and Managers (January 28, 2010, 2:00 p.m. - 3:00 p.m.) Participants

Ms. Denise Keehner, Director, Standards & Health Protection Division
Ms. Suzanne Rudzinski, Deputy Director
Dr. Edward Ohanian, Director Health and Ecological Criteria Division
Dr. Rita Schoeny, Senior Science Advisor, Office of Water

In OST, as in other parts of EPA, good public policy decisions depend on sound science, which depends on data. EPA "runs into criticism" when it makes decisions without "hard science data" and relies instead on assumptions or default procedures. One manager characterized the key question facing decision makers as "how do I get a pretty good answer that is not arbitrary and capricious, which I can defend in a regulatory arena."

OW has "some problems specific to OW:"

- None of the statutes it implements provide authority to mandate collection of health effects data.
- The Safe Drinking Water Act (SDWA) gave OW obligations in terms of science: the office must review the "best available peer-reviewed, publicly available data." The definition of "best" is left for OW to define and may be controversial
- SDWA requires EPA to consider sensitive subpopulations: not just children but also other populations that are innately susceptible or that have increased exposure. OW must address aggregate and cumulative risk in assessments that underlie risk management choices.
- Water is a complex mixture and so OW is drawn into analyses and policies involving the impacts of mixtures on human health and the environment.
- OW is obliged to consider potential risks of microorganisms living in water. These risks could be incurred through consuming water as well as through recreational use of waters.

ORD's resources are not sufficient to meet OW 's long list of needs. OW needs applied science, in addition to long-term research. Some of the types of research OW critically needs are not within ORD's purview or priority interests. OW timelines may not permit waiting for studies to be designed and completed, and may require the use of existing science generated by EPA or external to it. Dialogue between OW and ORD is "getting better," but OW's need for science will increase and with it the need for ORD responsiveness. With new risk assessment science, including EPA's 2005 *Cancer Guidelines*, EPA no longer will be relying only on linear low-dose extrapolation for cancer assessment or analyses where cancer trumped all other effects. The *Cancer Guidelines* emphasize the use of data analyses before invoking defaults as part of the need for a "sounder scientific base for human health". OW's science must be defensible in court, as well as in the court of scientific opinion. OW maintains a strong need for ORD data in the short term as the basis for chemical and microbial risk assessments.

OW participates in problem formulation for chemicals under consideration to determine regulatory options available for them. Under SDWA there is a requirement for formal periodic review for chemicals on OW's regulatory agenda for drinking water, the Contaminant Candidate List. There is a less formal periodic evaluation of chemicals under the Clean Water Act (CWA). OST interacts with the Office of Groundwater and Drinking Water in planning assessments needed for drinking water chemicals.

An example of science integration that involved problem formulation and interactions across federal agencies was joint advice developed by EPA and the Food and Drug Administration (FDA) on consumption of fish contaminated with methyl mercury. After evaluating the science, FDA and EPA agreed that the overall message should be that "fish is good food and all fish is contaminated with methyl mercury." Since no one can "extract mercury out of the fish," the fish advice focused on encouraging fish consumption while reducing exposure to mercury. EPA developed a reference dose (RfD), i.e., , an amount that can be consumed over a lifetime without expectation of adverse effect. This was based on the best publically available science of a methyl mercury effects, and included input from both the National Academy of Sciences as well as another independent expert group. This RfD was used by FDA as a comparison point in analyses to determine the optimal means for promoting fish consumption while minimizing mercury exposure EPA and FDA initially developed a four-page fish advisory, which was too long and complicated to be understood by the target audience. The Agencies subsequently involved risk communication specialists. FDA held focus groups, and both Agencies engaged stakeholders, as well as asked for and responded to public comments. OMB was also involved as there were economic consequences.

There are many new areas where the integration of science into policy will be important:

- For polyfluorinated compounds (PFOA and PFOS), there is a need for careful communication of risks, based on the limited available data
- For pharmaceuticals and nanotechnology products in water, there will be a need to frame the potential problems related to human health and ecological effects to focus research in this new area

There is a need for ORD to communicate its research to OW managers and senior staff in ways that engage them and help them understand the potential contributions of the research to OW's mission and research priorities. The main purpose of the National Water Program Research Strategy is to facilitate such an interface between ORD and OW. This is especially important for ORD's ecological services research program and the computational toxicology program. These are areas in which it is important that there be translation by scientists and risk assessors of impacts and consequences of the data. This is time- and resource-intensive, but very necessary to ensuring that risk management decisions incorporate the most contemporary, best science.

SAB Science Integration for Decision Making Fact-Finding Meeting
Office of Water, Office of Wastewater Management
EPA East, Washington, DC
January 20, 2010

Two members of the SAB Committee on Science Integration for Decision Making conducted one interviews in EPA's Office of Wastewater Management (OWM): Drs. James Johnson and Gary Sayler. Dr. Vanessa Vu, Director of the SAB Staff Office, provided a brief introduction to the purpose of the interview and the Designated Federal Officer, Dr. Angela Nugent, took notes to develop a summary of the conversation. All interviewees were provided a copy of the committee's Preliminary Study Plan in advance.

Dr. Vu noted in each interview that the purpose of the interview was to help SAB Committee members learn about OWM's current and recent experience with science integration supporting EPA decision making so that the SAB can develop advice to support and/or strengthen Agency science integration efforts. Dr. Vu thanked participants for taking time for the interviews.

Meeting with the Office of Water, Office of Wastewater Management Office Director and Management Team (11:00 a.m. - 12:30 p.m.) Participants:

Mr. James Hanlon, Director
Mr. Randolph Hill, Deputy Director
Ms. Sheila E. Frace, Director, Municipal Support Division
Ms. Deborah Nagle, Associate Division Director of the Water Permits Division

Usually, OWM applies science generated by others in its permit decisions, rulemakings, and policy letters. The office becomes more actively involved in science when science must be created to address a new issue specifically for OWM, as for the "vessel general permit," where the office used and adapted existing scientific information and worked with other federal agencies, such as the U.S. Coast Guard, to better understand potential environmental impacts caused from vessel discharges and to develop control measures for vessel discharges. OWM faces court orders and time constraints for assessing available information and only conducted very cursory peer review. OWM is planning to seek advice from the SAB in the future for modifications to the general permit relative to technologies for reducing endangered species from ballast waters.

OWM also sought special science for decision-making at the suggestion of stake holders for reauthorization of the wastewater program. OWM sought science advice from the National Research Council to strengthen its storm water program. Another focus has been generation of science to strengthen voluntary programs. OWM has encouraged research for the "Water Sense" voluntary program for water conservation.

Stakeholder involvement happens in the OWM process through traditional means (e.g., public comment on rulemakings, policy decisions, and permits, and public meetings) but generally does not focus on science issues.

OWM recently participated in a new OW research strategy and is working with ORD and the Water Environment Research Foundation on research related to infrastructure, guidance for municipalities, and nutrients.

Impediments for integrating science for decision making include:

- Lack of data due to impediments such as the information collection requirements under the Paperwork Reduction Act.
- Conflicting interpretations of available science
- Political or economic factors that make science-based options difficult to implement.
- Scientific recommendations difficult to implement because of statutory constraints
- Funding for the 104(b)(3) program (which was a grant program that funded scientific studies) was eliminated from EPA's appropriations several years ago.

OWM foresees future science needs related to emerging contaminants in wastewater (e.g., micro-contaminants, nanoproducts, pharmaceuticals, total dissolved solids from mountaintop mining, extracted waters generated by technologies used for Marcellus Shale drilling, residues from scrubber gas technologies, and nutrients). The human health and ecological risks have not yet been identified for these emerging contaminants and appropriate water treatment technologies have not been fully vetted. In addition, water contamination can be a highly political issue, since there are high civil penalties for permit violations.

OWM must participate in strategic research planning, so that future science needs get attention from ORD and outside scientific organizations. OWM seeks a clearer process for research planning with ORD and opportunities for more effective coordination on wastewater program research needs.

SAB Science Integration for Decision Making Fact-Finding Meeting
Office of Water, Office of Wetlands, Oceans and Watersheds (OWOW)
EPA West, Washington, DC
January 20 and 28, 2010

Five members of the SAB Committee on Science Integration for Decision Making conducted two interviews in EPA's Office of Wetlands, Oceans, and Watersheds (OWOW): Drs. James Johnson and Gary Sayler in person, and Drs. Terry Daniel, Wayne Landis, and Thomas Theis by telephone. Dr. Vanessa Vu, Director of the SAB Staff Office, provided a brief introduction to the purpose of the interview and the Designated Federal Officer, Dr. Angela Nugent, took notes to develop a summary of the conversation. All interviewees were provided a copy of the committee's Preliminary Study Plan in advance.

Dr. Vu noted in each interview that the purpose of the interview was to help SAB Committee members learn about OWOW's current and recent experience with science integration supporting EPA decision making so that the SAB can develop advice to support and/or strengthen Agency science integration efforts. Dr. Vu thanked participants for taking time for the interviews.

Meeting with the Office of Water, OWOW Deputy Office Director and Management Team (January 20, 2010, 3:45 p.m. - 5:00 p.m.) Participants:

Ms. Suzanne Schwartz, Deputy Director, OWOW
Mr. Darrell Brown, Associate Director, Oceans and Coastal Protection Division
Ms. Lynda Hall, Acting Associate Director, Wetlands Division
Mr. Robert Wood, Acting Associate Director, Assessment and Watershed Protection Division (AWPD)
Mr. Dov Weitman, Chief, Nonpoint Source Control Branch, AWPD
Mr. Susan Holdsworth, Chief, Monitoring Branch, AWPD

OWOW has a diverse array of responsibilities, including some regulatory activities, such as wetland permitting; semi-regulatory activities; technical monitoring; and non-regulatory activities supporting state, tribal, and local watershed group efforts. Ecological and social sciences, including science related to ecosystem services, are used in many different ways, but it is not always easy to integrate science into decisions and actions. There is often pressure to make a variety of decisions within tight timeframes and other obstacles to science integration.

In the nonpoint source program, OWOW principally uses science to guide voluntary decisions. The nonpoint source program receives little support from Office of Research and Development (ORD) but it does benefit from research and development conducted by the U.S. Department of Agriculture (USDA) and from research conducted by states and nongovernmental organizations funded by EPA grants. Demonstration grants for nonpoint source controls, such as nutrient management to reduce fertilizer applications to crop land, are very important for the growth of the program.

The oceans and coastal protection program relies on biological and ecological science different from the science developed for EPA's water quality and standards program, which focuses on science related to water quality in a water column. OWOW's science needs, in contrast, focus on ecosystems as a whole. ORD has undertaken only limited landscape-scale research projects, and it has been difficult to align OWOW's needs with ORD's research. Lacking support from ORD, OWOW has benefited from scientific collaboration with states that have pulled together landscape-level information relevant to nonpoint source programs and from states and communities that have providde science tools for understanding estuary problems. EPA is relying on science from the U.S. Coast Guard for issues related to endangered species in ballast water.

ORD's new research focus on ecosystem services has potential for OWOW. The ecosystem services research program has some activities focused on wetlands and nitrogen removal efficiency, but both ORD and OWOW need additional dialogue and time to understand how ORD's research could advance OWOW programs. There may be possible benefits in research on carbon sequestration and greenhouse gas emissions related to climate change. OWOW managers expressed appreciation for ORD's efforts to reach out to them as potential clients for ORD's ecosystem services research. One manager pointed out that, unlike the Office of Ground Water and Drinking Water, which has its own multi-year plan focused on drinking water research needs, OWOW must compete with the water quality standard program for the water multi-year research plan and with other agency programs for the ecosystem services research plan in identifying priorities for ORD's attention.

Currently, the wetlands program works with the U.S. Fish and Wildlife service database containing information on the national acreage of wetlands. This data set provides the best available information, but does not address the ecological condition of wetlands. The information is so limited that OWOW only describes the limitations qualitatively and has not developed a mathematical confidence assessment. Since a 2001 Supreme Court decision on isolated waters and the classification of wetlands, EPA scientists have worked with external scientific community through the American Water Resources Association to stimulate scientific discussion of the definition of wetlands. These external expert discussions may have an influence on future definitions of wetlands and their relationship to waters of the United States. The wetlands program has also consulted with the National Research Council (NRC) to provide a comprehensive review of science related to the wetlands program. The NRC report provided the foundation for changes to wetlands mitigation rules.

In general, NRC and SAB advice provide strong support for OWOW program plans. The SAB report, *Hypoxia in the Gulf of* Mexico, for example, provided language that was accepted by EPA's inter-agency partners and incorporated almost verbatim into the Inter-agency Hypoxia Task Force report. Taking decisive implementation action, however, is "tougher," and does not simply rely on scientific judgment, but on political will.

OWOW has mechanisms to seek advice from other outside scientists and factors their input into Agency science assessments. The National Aquatic Resource Surveys are implemented in partnership with states and OWOW has responded to survey results. The National Lakes Assessment is provided in draft for comment. The Total Maximum Daily Load

(TMDL) Program has a cooperative agreement with the Environmental Law Institute for holding listening sessions to improve integration of monitoring into TMDLs. OWOW has refined its science and methodology in response to feedback and has formed a "Linkages Group" in OW to discuss the relationship between TMDLs, Office of Wastewater Management programs, and water quality assessments conducted by the Office of Science and Technology; the purpose of the group is to discuss best practices for addressing non-point source pollution. Public involvement and response to public feedback are part of OWOW's culture, an "organic part of the process," because of the strong role played by voluntary programs.

Politics and changing policy are principal barriers to science integration for OWOW. For the most part, OWOW "struggles to get appropriate data and analyze that information to inform decisions," but politics also influences how science is used. Politics especially come into play when there are high costs, complex science issues, and "lots of public scrutiny." Decision-making tools like Region 3's "Logic Model," may be useful to inform decisions, but it is unclear whether the regulatory and non-regulatory system would have the tolerance for the level of detail and costs involved in working through such an elaborate system. Some OWOW managers acknowledged the possible utility of decision support science tools but expressed concern that such tools might lead to decision outcomes that EPA may be unwilling or unable to implement. One manager expressed the view that most disagreements over environmental issues reflect differences in values or perspectives, rather than different interpretations of science, although science is often used as a surrogate for policy differences.

Meeting with the Office of Water, OWOW Scientific Staff (January 28, 2010, 9:45 a.m. - 11:00 p.m.) Participants:

Brian Rappoli
Chris Faulkner
Donna Downing
Laura-S Johnson
Michael Scozzafava
Rachel Fertik
Robert Goo
Susan Holdsworth

Scientists began the discussion by providing their individual perspectives on science integration for decision making. One participant identified the lack of comprehensive monitoring of water bodies as the most significant impediment to science integration. Without that feedback mechanism, EPA cannot evaluate the effectiveness of its water pollution programs. It cannot understand dynamics across pollutants, interactions across media, or ecosystem effects or practice adaptive management. Even available monitoring data for the storm water program does not provide data designed to address real risk management questions. If water quality were more effectively monitored, EPA would be able to better choose between infrastructure and treatment systems and urban designs that would have a suite of potential benefits.

Other scientists observed that water quality monitoring is a "patchwork," with monitoring conducted by individual states with limited resources and inconsistent approaches. OWOW

scientists have the goal of promoting more consistent use of analytical methods and generation of more consistent field data, but few states collect ambient monitoring data and few states use data for the purpose of permits. The most effective strategies are to work with states to identify common goals, build technical capacity and encourage peer-to-peer information sharing. OWOW staff have seen successes with regional-scale work groups, where, for example, the Sate of Delaware has provided a model for other states to emulate. Stakeholders have shown interest in using state science, but OWOW staff have a concern about stakeholders "watering down" monitored data and analyses of those data.

OWOW has seen state monitoring programs affected by reduced state budgets as states lose key technical staff. state employees cannot attend peer networking events, and states struggle with information technology and ability to communicate with EPA. Interruptions in monitoring systems create "fundamental holes that affect what we can understand." In addition, given the way the TMDL program works, there may be a "perverse disincentive" to monitor. If states do not monitor, they will not have impaired waters to report under section 319 of the Clean Water Act, and they won't be required to develop resource-intensive and potentially controversial TMDLs for those impaired water bodies.

Monitoring is also a problem for EPA's beach program and ground water program. States can cut their entire beach monitoring program, and "once you stop the program, it is "hard to start it up again. The National Coastal Assessment has provided information on the ecological condition of U.S. coastal waters. Increased resources could be used to improve and enhance the assessment by adding additional monitoring stations and indicators, thereby painting a clearer picture of conditions at the state level, and better informing decision makers. As for ground water monitoring, although EPA is advocating a larger groundwater effort on a basin-wide scale, there are generally diminishing state budgets and reduced resources for new monitoring activities.

Another participant identified budget limitations and regulatory inflexibility as the most significant impediment to science integration. EPA has very little flexibility to conduct new or innovative monitoring, once it prioritizes activities required by consent decrees and court orders. Given these constraints and the requirement in the Clean Water Act for states to set chemical-specific water quality standards, it will be difficult to implement an ecosystem services approach to protecting water quality.

Yet another participant described how the scientific work of the Wetlands Regulatory Division has been changed by the 2001 Supreme Court decision, which requires EPA to prove a relationship of a wetland to a navigable watercourse before the program can control polluters' activities through issuing a permit, cleaning up contaminated spills, or otherwise protecting a waterbody. The wetlands program is "data starved." It makes use of any available data, mostly generated outside EPA (e.g., U.S. Geological Survey data or aerial photography) to establish that a wetland is a water of the United States.

The wetlands program also participated in a symposium organized by Region 10's Tracie Nadeau, which resulted in a peer-reviewed issue of the Institute of Wetlands Science devoted to the issue of isolated wetlands. Scientists from the academic community reported on research

related to the relationship of wetlands to navigable waters and wetlands' contributions to ecosystem services. The issue has stimulated research in the academic community on key issues related to wetlands and perennial streams.

OWOW's science activities also include the Ocean Survey Vessel Bold, EPA's sole ocean and coastal monitoring vessel for both the Atlantic and Pacific Coasts. The ship supports monitoring needs for regions and program offices. Because of reduced budgets and because monitoring activities can be expensive. OWOW has encountered challenges to maintaining funding for this vessel and scientific studies.

OWOW also has new regulatory responsibilities associated with the Clean Boating Act and an act to regulate discharges from Alaskan cruise ships. These regulations require EPA to take action within a short time frame, with a limited budget, and limited available scientific information. It is difficult to collect sufficient data from boaters, given the resource and time constraints. Given the constraints, OWOW scientists have accessed available information from the U.S. Coast Guard, states, and secondary information from trade groups and associations and will characterize uncertainties and data limitations.

There are human resource barriers to supporting scientists in OWOW interested in science integration for decision making. There are few or no GS-14-level positions for environmental scientists working at a high level. Increasing program responsibilities require that scientists assume additional contract or grant management functions, which detract from scientific activities, science assessment, and efforts to keep current with scientific advances in fields of importance to OWOW.

EPA Office of Environmental Information (OEI) Toxic Release Inventory (TRI) Program Science Integration for Decision Making Fact-Finding Interviews
November 24, 2009
Washington, DC

Five members of the SAB Committee on Science Integration for Decision Making interviewed the Director of OEI's Office of Information Analysis and Access and Managers responsible for implementing the TRI Program. Drs. James Bus and James Johnson conducted the interview in person with participation by phone from Drs. Catherine Kling, Jill Lipoti, and Thomas Theis. Dr. Angela Nugent, Designated Federal Office for the committee, provided a brief introduction to the purpose of the interview. She also took notes to develop a summary of the conversation. All interviewees were provided a copy of the committee's Preliminary Study Plan in advance.

Dr. Nugent noted in each interview that the purpose of the interview was to help SAB Committee members learn about the TRI Program's current and recent experience with science integration supporting EPA decision making so that the SAB can develop advice to support and/or strengthen Agency science integration efforts. Dr. Nugent thanked participants for taking time for the interviews.

Interview with the TRI Managers

Participants:

Mr. Rick Martin, Acting Director, Office of Information Analysis and Access
Ms. Michele Anders, Acting Deputy Office Director, Office of Information Analysis and Access
Mr. Michael Petruska, Director, Toxic Release Inventory Program Division
Ms. Nancy Wentworth, Director, Environmental Analysis Division and Acting Associate Office Director, Office of Information Analysis and Access

SAB members began the interview by asking managers about their role in three parts of the TRI program where EPA makes decisions based on science input (where decisions involve adding a chemical, setting a threshold level, or delisting a chemical). They asked interviewees to describe their role and how they use science. The first topic discussed was chemical listing. Staff in the Environmental Analysis Division, following the mandate in Emergency Planning & Community Right-to-Know Act (EPCRA), develop a hazard assessment that addresses acute and chronic hazards that relate to both “fence-line exposure" and exposures to the general population. They emphasized that the TRI program is mandated to assess hazard, not risk. The TRI program has historically faced a challenge. The public often sees hazard listing and becomes concerned. EPA tries to communicate that the “number’s significance depends on the exposure pathway,” but that message is difficult to communicate.

EPA must work within the legal framework provided for the TRI program and use science to achieve practical results. The TRI chemical list includes approximately 600 chemicals. Most are identified in the original statute, and the listing of some chemicals “had no scientific rigor compared to today’s requirements for listing.” Although some listed chemicals have never been reported or are produced in low quantities, EPA cannot take the chemicals off

the list without performing a full hazard assessment and it may not be worth the trouble to take on such work.

The TRI program does look to add chemicals; the statute provides criteria for listing (e.g., hazard, production volume, volume in commerce). Sometimes the program takes the initiative; at other times, it responds to suggestions from other EPA programs that need information or to public petitions. Decisions to list chemicals must satisfy the listing criteria and also meet information collection request requirements under the Paperwork Reduction Act. When EPA decides to list a chemical, it prepares a full human health and ecological hazard assessment, which is peer reviewed, and then proceeds with a full notice and comment process. For persistent bioaccumulative toxicants (PBTs), where there is a concern at a lower level, there is a lower reporting threshold as "chemicals of special concern." Such chemicals receive an additional level of documentation and scrutiny. Managers and TRI science staff are aware of controversy over application of PBT criteria to metals and inorganic metal compounds, and the designation of metals and inorganic metal compounds as PBTs.

Staff work hard to stay current with the literature and participate in EPA's Risk Assessment Forum. They monitor the activities of the National Toxicology Program, participate in Scientific Advisory Panel meetings, and keep aware of national and international debates on those scientific issues. Peer review plays a major role in ensuring quality science. Managers also mentioned that listed chemicals must be reported by listed industry sectors. They discussed recent initiatives to list the mining and electrical utility sectors and noted that currently the agricultural sector is not listed, but that if it were, it would be possible for Concentrated Animal Feeding Operations (CAFOs) to have reporting requirements.

SAB members asked about the protocol for hazard assessments. Managers responded that scientists take a weight of evidence approach and rely on peer-reviewed information. One manager noted possible efficiencies in using more National Toxicology Program assessments. In response to a question about possible use of ToxCast information for chemicals that haven't been tested, a manager responded that such information would not be used by the TRI program until related toxicity issues are resolved in the scientific community.

Managers noted that the TRI Program does not have an independent monitoring requirement. Much of the reported data is estimated, not measured, in the field. This poses interpretation problems for data users. The TRI data elements contain metadata which indicate how the data were derived (e.g., monitoring, engineering estimates, etc.) EPA provides data users with a document describing "factors to consider" in using TRI data. EPA also provides data providers (reporting facilities) with instructions on filling out the TRI form, including providing appropriate metrics for release estimates and choosing appropriate descriptions of the basis of estimate (e.g., whether reported quantities are measured or monitored). Nevertheless, sometimes the information provided, like a single number for an entire chemical facility for an entire year, could be a mix of modeled and monitored data. The statute requires submitters to provide the best information they have. EPCRA specifically prohibits EPA from requiring monitoring or requiring the taking of new measurements to improve reporting. However, in some cases, another EPA program institutes a new monitoring requirement (e.g., air monitoring

for mercury was recently required for some sources under the Clean Air Act), and when that happens, many more facilities use measured date in TRI.

EPA currently provides a level of quality control on the reported data to identify anomalies or gross mistakes in reporting. In some cases, EPA contacts facility operators to verify data they have submitted. If data are incorrect, EPA allows facilities to revise their submissions to provide the correct data. In egregious cases, submission of poor quality data may also be considered a violation of EPCRA reporting requirements.

To communicate the TRI results, EPA both provides written narrative documents, such as the document Key Findings (http://www.epa.gov/tri/tridata/tri08/national_analysis/pdr/TRI_key_findings_2008.pdf), and the Agency also tries to provide tools at different levels of sophistication for different audiences (http://www.epa.gov/tri/tridata/index.htm). Envirofacts is very detailed. TRI.Net provides very sophisticated analysis and notes. TRI Explorer is a more "general public" oriented tool. These tools allow people with varying information needs and computer skills to analyze/evaluate chemicals and use TRI data for their own decision making.

There is much interest in TRI data, especially in underserved, environmental justice communities. The Office of Pollution Prevention and Toxics uses TRI data to evaluate baseline risk.

SAB members asked whether EPA uses social science to determine whether people are "getting what they need to know." A manager responds that EPA does "usability testing" and beta testing for specific audiences. The Office of Environmental Information (OEI) has a network of user groups developed as part of its work on the *Report on the Environment* and OEI's national dialogue on environmental information, conducted over the past two years. These groups identified the kinds of information desired and modes for providing information. The TRI program makes use of this information. OEI also has a cooperative agreement with the Environmental Council of the States (ECOS). Under the ECOS agreement, EPA and ECOS sponsor both a website (www.chemicalright2know.org) and a national conference to bring together stakeholders and data users to discuss TRI and related topics of interest.

Managers also noted that the TRI program is trying to engage the public with web 2.0 tools. The ECOS cooperative agreement as a web 2.0 tool platform for dialogue, which provided input for the mining sector regulations. The mechanism provides direct interaction on a broader scale. The TRI program is also exploring possible use of the National Environmental Justice Advisory Committee and National Advisory Committee for Environmental Policy and Technology. One manager noted that "with so many different audiences, delivery mechanisms need to be quite flexible, which poses a big challenge and requires vision." Historically, TRI data have been used by a limited number of non-governmental organizations (primarily Right-to-Know Networks). Information technology and Data.gov may be changing that profile. More individuals are downloading raw TRI data, but the driving rationale for that change is not clear and needs to be explored.

A manager noted that the Administrator currently has directed the TRI program to consider enhancements for involving communities in the TRI program, including enhanced tools for communication. The program is "just at the brink of taking new look." The effort will probably involve regions in new efforts to engage with communities and facilities. EPA has also recently created a TRI steering committee to review possible regulatory changes and seek enhanced ways to engage with communities. The Director of OEI's Office of Information Analysis and Access co-chairs the steering committee with the Region 9 Communities and Ecosystems Division Director.

One recent initiative, responding to public feedback, has involved providing TRI data more quickly. In 2009, the TRI reporting deadline was June 30 for releases occurring in 2008. 80% of TRI data were available in August and 100% in September. Another public request is to provide more context and risk information; EPA is considering how that can be done.

The managers then discussed issues related to their scientific and technical work force. One manager noted that staff have individual development plans and attend professional meetings. TRI scientists participate in Agency work groups. She maintains a "sturdy" travel and training budget so people can stay certified. Managers noted that staff have a strong desire to be competent leaders in their field and are passionate about science in their program. Managers noted that there hasn't been a need to retrain staff when new sectors have been added; the skill set for the TRI scientists has not changed. If there are questions related to new sectors, contractors address those issues.

Another manager noted that there is an annual TRI conference with participation from states, tribes and environmental groups. The conference has in the past noted emerging issues (e.g., air emissions, mercury from mines) that have lead to TRI program changes

Managers noted that politics and policy, not science, sometimes drive the TRI program. At times, the political leadership is not interested in expanding the program. At other times, there is an "appetite for pro-active program management." Currently, staff are looking at "pent-up listing" possibilities for new chemicals.

Interview with TRI Staff

Participants:

Dr. Daniel Bushman, TRI Petitions Coordinator and Chemical List Manager, Environmental Analysis Division

Dr Stephen DeVito, Chairperson of EPA's Office of Information Access and Analysis' TRI Data Analysis Team

Dr. Nicole Paquette, Chief, Analytical Support Branch, Environmental Analysis Division

In the first part of the discussion, TRI staff described the intent of EPCRA section 313, its statutory provisions, and the purpose of the TRI. The staff stated noted that EPA's TRI program is by its very nature a nationally-based multi-environmental media program. Hence, hazard assessments performed by the TRI program must, by necessity, be broad to encompass all environmental media and all environmental conditions in order to properly characterize the hazards of chemicals following their release into the environment.

The scientists described their role in supporting Agency decision within the framework provided by EPCRA. Staff conduct chemical assessments of environmental fate, human health, and ecological hazards to support proposals to list chemicals. They generally rely on IRIS assessments but in the past have conducted a "whole assessment" independently. Their work is peer reviewed. They noted that listing decisions have not been active over the last eight years but are "starting up again."

SAB members asked how scientists manage to restrict their analysis to hazard, without broadening the analysis to discuss risk. Staff acknowledged that they "walk a fine line" and try to focus on the "inherent toxicity of chemical we assess." Such an approach is consistent with IRIS assessments, but analysis of acute effects, by definition, involves assumptions about exposure. One staff member noted that the TRI program has delisted chemicals where it has determined these chemicals do not cause chronic human health or ecological effects, and "beyond the fence line" concentrations would not result in exposures that would cause acute or human or ecological effects, or for which available data do not support continued inclusion of a chemical on the TRI list of toxic chemicals.

The TRI program is not required to conduct risk assessments when deciding whether a chemical should be listed onto or delisted from the TRI list of toxic chemicals. However, in addition to characterizing a chemical's toxicity and environmental fate, as a practice the TRI program generally considers whether exposure pathways exist to organisms (i.e., humans) sensitive to the toxic properties of a given chemical and its environmental metabolites. An example of such was the delisting of barium sulfate, a metal compound. Barium and its compounds (including barium sulfate) were included on the original TRI list of toxic chemicals, which was established by Congress and given to EPA. The TRI program was petitioned to delist barium sulfate from the TRI list of toxic chemicals.

The staff emphasized that a hazard assessment of a metal conducted by the TRI program involves the identification and integrated assessment of data and information pertaining to: the chemistry and fate of the metal in all media and under the range of different environmental conditions that exist throughout the United States; its environmental transformation products; the bioavailability of the metal and its environmental transformation products in humans or other organisms; the environmental accessibility of the metal ion from the form in which the metal was released to the environment, or from environmental abiotic or biotic transformation processes; and the known or anticipated toxic effects that the metal or its environmental transformation products may have on human health or the environment.

In its subsequent hazard assessment of barium ion and barium sulfate, the TRI program concluded that barium ion is toxic to humans and the environment and can be liberated from barium sulfate in the environment. Nonetheless, the TRI program concluded that barium sulfate should be delisted from the TRI list of toxic chemicals. The basis of the TRI program's decision to delist barium sulfate was that: liberation of barium ion from barium sulfate occurs only under certain anaerobic conditions found in stagnant water bodies that have low sulfate concentration and that are cut-off from surface and ground waters; and if barium ion formed as such migrates into ground or surface waters it will react essentially instantly with naturally occurring sulfate to form insoluble and non-toxic barium sulfate; and the environmental life-cycle of barium ion does

not give rise to human or environmental concerns. In general, however, the statute requires that, for delisting, a chemical must have "no known toxicity." If there's a doubt, EPA would characterize the doubt and keep the chemical on the list.

The TRI scientists noted that in general, the TRI program relies on peer-reviewed information generated by EPA. Where that information is not available, the TRI program seeks other information with high integrity. The TRI program's 2004 chemical assessment guidelines provide internal guidance for conducting assessments. EPA's TRI assessments are provided for public comment in the Federal Register.

An SAB member asked whether and how TRI staff might use ToxCast information or high-throughput analyses for TRI assessments. Interviewees responded that most of those data are "virtual" and the result of modeling. The TRI program relies on "concrete" toxicity data. They have made some limited use of information based on structure-activity relationships, but wouldn't feel comfortable using more assessments based on modeling, unless the data were peer-reviewed and validated. They discussed perfluorooctonoic acid (PFOA) and PFOS as two chemicals that did not have sufficient toxicity information of the kind needed for TRI listing.

Scientists noted that the TRI program itself has no mechanism to fill data gaps in a hazard assessment, which must be conducted within a short time frame. Staff noted that the TRI program imposes reporting requirements only. Since it does not restrict use of a chemical, the program makes calculated judgments about how much effort to put into the supporting data gathering.

Staff then discussed ways in which they participate in dialogue with scientists in other organizations to keep abreast of developments and ensure consistency in weighing data. Scientists responded that the TRI program develops work groups for regulatory actions; usually scientists from OAR and ORD participate. Responding to petitions requires interaction with petitioners. The TRI program tries to follow EPA guidelines (e.g., the neurotoxicity and cancer guidelines) to guide decisions even on chemicals where EPA does not have a fully developed risk assessment. The scientists noted that for emerging chemicals, like nano-technology, the TRI program is waiting for the toxicology database to grow. Science is needed to establish the hazards of nano-chemicals and to identify meaningful thresholds for TRI reporting.

Interviewees next focused their discussion on drivers and impediments to science integration. Scientists initially responded that their focus was narrow, based on EPCRA's mandate for hazard assessment. The SAB interviewers asked about efforts to use social sciences to understand how people use TRI information and how the program can help them make better use of it. One scientist noted that 30 EPA programs use TRI on a semi-regular basis and that there are a wide range of industry, environmental groups, citizen groups, and international groups that use the data. Scientists have cooperated with program managers in developing tools to help the public understand and use TRI data. Scientists spoke of the value of TRI.Net (designed for researchers), which allows people to conduct combine TRI data with other kinds of data overlays. Scientists are also providing enhanced tools to help the public to access hazard information related from a wide variety of sources (e.g., IRIS, CalEPA, and ATSDR) related to TRI chemicals. TRI.Net and TRI Explorer provide guidance on how to interpret information,

especially estimated TRI data. Scientists noted that another system, Envirofacts, allows users to compare TRI data with monitoring for national emission inventories. The user guide for the TRI Explorer describes these other information sources, but the TRI Explorer itself does not point to the National Emissions Inventories.

Scientists noted that EPA currently conducts limited internal data quality checks, because of the accelerated schedule for releasing TRI information. Current data quality checks only identify relatively huge outliers.

Staff discussed limited resources as a major barrier to science integration. When the TRI program was moved to the Office of Environmental Information, "we never were staffed up to level we've been supposed to." The program emphasis has been on information technology. The program currently has one toxicologist for all of its work. One interviewee stated "we're supposed to be doing science without scientists!" "We are utilizing contractors more." Scientists typically are constrained by using available IRIS information. Real integration is difficult, because most Agency science is driven by programs' mandates. The only toxicity information available might be a hazardous air pollutant assessment, but this information may be only of limited use to TRI.

On the positive side, staff noted a good budget for travel and training and the possibility of bringing on "young hires" with new knowledge.

The principal role for social science noted was for help with TRI communications. This need will grow if the TRI program moves in the direction of more community-based work.

EPA Office of Research and Development National Center for Environmental Assessment (NCEA) Science Integration for Decision Making Fact-Finding Interview
Telephone discussion, February 3, 2010

Four members of the SAB Committee on Science Integration for Decision Making conducted an interview with the National Center for Environmental Assessment (NCEA) Director and NCEA managers and scientists. Drs. James Bus, Terry Daniel, Thomas Theis, and Lauren Zeise conducted the interview by telephone. For the interview, Dr. Vanessa Vu, Director of the SAB Staff Office, provided a brief introduction to the purpose of the interview and the Designated Federal Officer, Dr. Angela Nugent, took notes to develop a summary of the conversation. All interviewees were provided a copy of the committee's Preliminary Study Plan in advance.

Dr. Vu noted that the purpose of the interview was to help SAB Committee members learn about NCEA's current and recent experiences with science integration supporting EPA decision making so that the SAB can develop advice to support and/or strengthen Agency science integration efforts. Dr. Vu thanked participants for taking time for the interview.

Meeting with National Center for Environmental Assessment (NCEA) Director and NCEA managers and scientists (2:00 p.m. - 3:30 p.m.) Participants:

Dr. Peter Preuss, Center Director
Becki Clark, Deputy Center Director
Dr. Lynn Flowers, Associate Director for Health
Dr. Mike Slimak, Associate Director for Ecology
Anne Grambsch, Global Team Lead
Kathleen Deener, Program Support Coordinator
David Bussard, Division Director
Dr. Mary Ross, Branch Chief

The National Center for Environmental Assessment (NCEA) Director opened the discussion by noting that NCEA is a key point at which science comes together to support decisions and issues are raised to influence critical future research for decision making. For example, NCEA's Integrated Risk Information System (IRIS) health assessments support many Agency programs. NCEA also develops Integrated Science Assessments (ISAs) for criteria air pollutants in direct support of the Office of Air and Radiation (OAR). NCEA's ecological program develops causal analysis schemes to understand deterioration in surface waters and streams, working with and supporting the Office of Water. NCEA staff in Cincinnati develops Provisional Peer Reviewed Toxicity Values, or PPRTVs, which are "short turn-around values" for use in the Superfund program.

In developing ISAs, NCEA works with OAR and EPA's air pollution research programs. NCEA works with other parts of ORD to help plan needed research. NCEA especially works with ORD's National Center for Environmental Research to develop Requests for Applications (RFAs) to meet the needs of NCEA assessments. A large number of the articles cited in ISAs come from ORD research or ORD-supported research grants.

NCEA's climate change assessment program has published a series of assessments of the impacts of climate change over the past five years. The assessments target an audience within EPA and a broader inter-agency and international audience.

The nature of NCEA's integration activities varies. For climate change assessments, NCEA works across ORD laboratories and centers and across federal agencies. For a 2002 air quality assessment, NCEA drew on information from ORD laboratories and centers and external research organizations to create an assessment that defined research needs for the Pacific Northwest Research Laboratory and Department of Energy research on air quality.

An NCEA synthesis report, *Assessment of the Impacts of Global Change on Regional U.S. Air Quality: A synthesis of climate change impacts on ground-level ozone* (EPA/600/R-07094P) provided key information for the Agency's Endangerment Finding on greenhouse gases. The assessment resulted from a long-term collaborative process that involved engaging the external research community through the STAR program and internal scientists in constructing a variety of climate change models and then working with the external academics, ORD scientists, and OAR representatives to prepare NCEA's synthesis and assessment report. An extensive and transparent review process, combined with NCEA's approach to the assessment, increased the confidence lawyers felt in the results of the synthesis report. In addition, NCEA's Global Team worked with OAR to address the more than 400,000 comments that were received during the public comment process for the Endangerment Finding. NCEA's climate work involves major efforts to collaborate with program offices, EPA scientists and external scientists in academia and other federal agencies. This collaboration has contributed to the value of NCEA work products.

For its global program, NCEA generally relies on a "participatory research approach" for involving external stakeholders and scientists. To follow up on studies on the mid-Atlantic region, Great Lakes, and Climate Ready Estuaries, NCEA's Global Team has sought information about the users of NCEA reports to determine if they find them useful. The center would like to conduct this type of follow-up for other NCEA work products.

In applying the causal analysis system to deterioration of streams, NCEA worked with stakeholders and states to determine needs for the model with the goal of making the model usable while meeting their needs.

For criteria air pollutants, NCEA interacts on a continuous basis with its OAR client and brings work products to the Clean Air Scientific Advisory Committee for iterative review. For these pollutants, problem formulation is part of the analytical process. ORD and OAR focus on defining policy-relevant questions at the start of a National Ambient Air Quality Standard (NAAQS) review. The questions guide development of the ISA, along with a causality framework that calls for use of consistent language about causality in ISA's. NCEA's ISA provides the scientific foundation for Risk, Exposure and Policy Assessments that are prepared by OAR, as well as the decision-making process. The NAAQS review process is highly structured. A description of the NAAQS review process is available at http://www.epa.gov/ttn/naaqs/review.html. These processes incorporate many of the

recommendations in the National Research Council's report, *Science and Decisions: Advancing Risk Assessment*.

Interactions with other scientific organizations nationally and internationally can take many forms. For IRIS chemicals, NCEA has coordination efforts within the United States. For example, NCEA has signed a Memorandum of Understanding with Cal/EPA to work more closely on risk assessments, share information, and avoid overlapping efforts. On the international front, Dr. Preuss sits on the steering committee of the International Program on Chemical Safety (IPCS) and NCEA scientists serve on all the subcommittees of the IPCS. The Organization for Economic Cooperation and Development (OECD) has agreed to include IRIS information on OECD's list of assessments. Additionally, NCEA is working with the Netherlands on new methods and approaches to probabilistic risk assessment. NCEA participates in the Convention on Biodiversity to develop guidelines to address risks of invasive species, and NCEA scientists have played a large role in developing the guidelines. NCEA's climate change work requires a lot of staff involvement with the Intergovernmental Panel on Climate Change. NCEA staff participate in a variety of professional societies.

NCEA employs several strategies to adapt to changing needs for assessments and changing science. There has been a global change group within NCEA since the mid 1990s as a result of the 1990 Global Change Research Act. The group has been multidisciplinary, and it helped lead the first National Assessment in 2000. There have been recent hires to build expertise in regional modeling. NCEA supplements its expertise through the American Association for Advancement of Science fellows and through use of contractors. NCEA has a unique multi-disciplinary capacity and is looking to see how it could contribute to ORD's new integrated, multidisciplinary research efforts.

Although some NCEA activities serve a single program (e.g., ISAs for OAR and PPRTVs for Superfund), other activities cut across EPA programs. NCEA, for example is responsible not only for IRIS chemicals, but also is responsible for providing a report on biofuels and alternative energy sources and for climate change assessments. In these efforts, NCEA works without the constraints of EPA's "stove-piped" organization by focusing on the needed science product, forming Agency work groups, and coordinating across federal agencies and with outside scientists. Sometimes it is difficult to provide science products in all these arenas when customers need them.

It is also sometimes difficult to take sufficient time for planning NCEA activities, problem formulation, and communicating NCEA results to interested and affected individuals. The daily press of business can overwhelm NCEA schedules. With the goal of ensuring good communications, NCEA has initiated trips to all EPA regions to talk about its activities, answer questions, and "make connections." Regional staff are interested in NCEA’s programs, including IRIS health assessments and assessments of regional impacts of climate change. NCEA also participates in annual meetings of regional risk assessors as a way of strengthening ties with regional risk assessors and providing information about relevant activities and assessments within NCEA.

NCEA also devotes resources to responding to regional queries. NCEA has designated one of its scientists to respond to regional questions. NCEA staff in Cincinnati report that they received 198 different information requests from regions in 2008 and were able to respond to 158 immediately. NCEA staff in Washington, D.C. provide guidance tor regions on requests. High priority regional requests (e.g., PCBs in caulk or Libby asbestos issues) may be identified in the weekly Administrator's staff meeting for immediate attention.

There is a process that allows regional needs for IRIS and PPRTVs to feed into a prioritization process and timeline for these chemicals. NCEA is currently setting priorities for its work on chemical assessments and has sought feedback from EPA's regions and program offices. As one example of NCEA's response to regional needs, the center has accelerated its health assessment of Chromium 6. NCEA would like to continue such efforts to adjust its priorities for chemical risk assessment to meet EPA users' needs.

NCEA also provides regions with assistance in the absence of an IRIS assessment. NCEA often receives requests for help for especially difficult compounds, such as formaldehyde, trichloroethylene, and dioxins. NCEA scientists listen to the requests for information and describe the kinds of existing assessments that are available in the literature [e.g., Cal/EPA values, Agency for Toxic Substances and Disease Registry (ATSDR) non-cancer values], whether those assessments are reasonably complete, and how those assessments relate to EPA's risk assessment guidelines. NCEA staff "typically do the best we can to do quick work with them to help them move forward, but we don't say EPA endorses" external assessments if IRIS values don't exist. NCEA relies on program offices, such as Superfund, to provide regions with guidance about default assessments to use if IRIS information is not available.

For NCEA, the principal barrier to science integration is lack of resources. There are "too many assignments and not enough people." NCEA prioritizes among the many requests for support by seeking projects and developing assessment products that allow the center to produce a "common good." If a request is unique to a particular setting, NCEA aims to develop an assessment product that will help EPA address environmental issues in other contexts.

There is a tremendous resource burden in responding to hundreds of freedom of information act requests, enquiries from constituent groups affected by regulations that depend on science, requests with congressional committees, and needs for clear communication about environmental assessments. All these needs, however, are part of NCEA's work in the context of conducting assessments in a regulatory agency. All the processes are time consuming, but necessary.

Science Integration for Decision Making Fact-Finding Interviews
EPA Office of Research and Development (ORD) National Health and Environmental Effects Research Laboratory (NHEERL) and National Exposure Research Laboratory (NERL)
January 25, 2010,

Five members of the SAB Committee on Science Integration for Decision Making conducted four interviews in Research Triangle Park: Drs. James Bus and Deborah Cory-Slechta in person and Drs. Terry Daniel, Wayne Landis and Thomas Theis by telephone. For each interview, Dr. Vanessa Vu, Director of the SAB Staff Office, provided a brief introduction to the purpose of the interview and the Designated Federal Officer, Dr. Angela Nugent, took notes to develop a summary of the conversation. All interviewees were provided a copy of the committee's Preliminary Study Plan in advance.

Dr. Vu noted in each interview that the purpose of the interview was to help SAB Committee members learn about ORD's current and recent experience with science integration supporting EPA decision making so that the SAB can develop advice to support and/or strengthen Agency science integration efforts. Dr. Vu thanked participants for taking time for the interviews.

Meeting with Director and Management Team, EPA Office of Research and Development (ORD) National Health and Environmental Effects Research Laboratory (NHEERL) (9:00-10:30 a.m.)

Hal Zenick, Director
Bob Hetes, Acting Director, Research Planning and Coordination Staff
Steven Hedtke, Associate Director for Ecology
Jennifer Orme-Zavaleta, Acting Director, Environmental Public Health Division
John Rogers, Acting Director, Integrated Systems Toxicology Division
Ram Ramabhadran, Acting Director, Toxicology Assessment Division
Carl Richards, Director, Mid-Continent Ecology Division
Mace Barron, Acting Director, Gulf Ecology Division
Jonathan Garber, Director, Atlantic Ecology Division
Thomas Fontaine, Director, Western Ecology Division

For the National Health and Environmental Effects Research Laboratory (NHEERL), science integration begins with the choice of research to undertake. NHEERL relies heavily on ORD's multi-year plans, developed in coordination with Program Offices, which identify research needs. Assistant laboratory directors interact with National Program Directors to keep research timed to regulatory actions. Reviews from the Board of Scientific Counselors indicate that ORD laboratories have improved their interactions with program offices and their implementation of multi-year plans in recent years.

NHEERL strives to develop an in-depth understanding of environmental problem to be addressed and the decisions to be made, whether they involve a regulatory decision or a voluntary program. NHEERL is always seeking to better understand the match between its

research and to the decisions to be made, rather than generate "fine research with imperfect application."

Program offices often do not clearly identify for ORD the highest priority questions to address. The Office of Air and Radiation, for example, presents four separate agendas for the Office of Transportation and Air Quality, Office of Radiation and Indoor Air, Office of Atmospheric Programs, where the climate change program is housed, and the Office of Air Quality Planning and Standards. It is rare for a senior manager in the Assistant Administrator's Office to meet with ORD lab directors to discuss overall priorities. The Deputy Assistant Administrator for the Office of Prevention, Pesticides, and Toxic Substances is unique among senior managers in the attention he has devoted to meeting with ORD to discuss priorities for his programs. Occasionally, ORD identifies priority issues that are "natural integrators" (e.g., pesticides of common interest to OPPTS and the Office of Water), but National Program Directors are looking for a more reliable way to identify priorities and to look across research portfolios in different areas to identify common issues, such as complex mixtures, that may be important to several program areas. The Science Policy Council has also begun discussing research priorities that need attention, but that process is only in an early stage.

Once ORD gets lists of research needs from different program offices, a laboratory looks at the capacity of its programs and determines what it is "realistically able to do." An SAB member asked whether there was a process to ensure that other science needs get addressed, so that ORD or a program office may turn to a contractor or use a grant mechanism to generate needed research or be prepared to treat the data gap as an uncertainty. No structured process of this kind exists to address those gaps.

ORD has changed its process for budgeting and funding to focus resources on research identified in multi-year plans. Following those plans, NHEERL is attempting to move to a model wherein resources are allocated to priority projects and related divisions and teams, and no longer to Principal Investigators. Budgets are to be tracked by project.

ORD has introduced human resource practices to encourage scientists to orient their research to support decision making. In grade promotion, ORD managers increasingly give recognition for research, conducted in teams, that has made an impact on decisions, in addition to more traditional factors, such as originality and creativity. Increasingly, ORD is giving less attention to the number of first-authored papers as a primary criterion for promotion. ORD has developed guidance for technical qualification that incorporates this new approach.

ORD managers aim to hire highly qualified experts in technical fields who have flexibility to work on different environmental research problems. Given limited authority to hire new employees, ORD has maximized its use of post-doctoral fellows. There is a need for ORD for strategic workforce planning with a five year horizon for critical hires. It is important to undertake such an effort and get it peer reviewed.

NHEERL does not have a formally established external network of experts to supplement NHEERL staff where there new expertise needs or NHEERL encounters a lack of capacity. Some innovative programs, such as the ecological services research program, have used

innovative contract and consultant mechanisms to reach out to social, economic, and behavioral scientists to supplement EPA's expertise. NHEERL however does coordinate with other federal agencies in several ways. It collaborates informally and shares data with other federal research organizations in RTP. It cooperates in inter-agency agreements related to specific issues. It cooperates with states, especially on ecological research, where there is a common interest. NHEERL is hesitant to have researchers compete for grants from other federal agencies, because it does not want to encourage researchers to have independent sources of funding at a time when ORD is seeking to encourage teamwork and collaboration related to priority research identified in multi-year plans. NHEERL does create Cooperative Research and Development Agreements (CRADAs) with industry to advance specific research goals

Barriers to science integration for NHEERL include:

- Federal personnel policies that make it difficult to remove researchers not flexible enough to shift their focus to supporting decision making
- EPA culture that does not explicitly "look at granularity of data needed for the decision to be made." For example, science needs may be different for priority ranking of Superfund sites, compared to a national rule. Research should generate science that links to the data needed and the decision supported.
- Few EPA program offices have invested in scientists with expertise to match NHEERL's. NHEERL needs partners in program offices that can identify "just how far you need to drill down to have sufficient information to make decisions."
- Inertia and unwillingness to changes how EPA uses science. EPA has become comfortable with using Reference Doses and is hesitant to explore new types of science, such as computational toxicology
- Most program offices focus on immediate program needs and emergency "fire fights" and few take the time to think about strategic science needs.
- Inconsistent practices across National Program Directors in engaging regional scientists in multi-year plans.

NHEERL does not have a formal mechanism for coordinating with regional scientists. Relationships may be stronger between the regions and the labs on ecological issues than on human health issues. Regions often contact NHEERL and other parts of ORD for technical support on issues that are "so yesterday," issues no longer a focus for NHEERL and for which NHEERL may no longer have expertise. ORD's Office of Science Policy has the lead for coordination with EPA regions and may provide the SAB with greater detail on this issue. The issue of technical support for regions is a complex one. ORD does not have a clear sense of what kinds of technical support regions need and how much support of each type. Technical support can be as simple as a phone call or can require extensive work that makes it impossible for ORD scientists to conduct their assigned research. Problems often arise after ORD has completed a project with a program office client (e.g., water quality criteria for ammonia). ORD scientists have moved on to other priority issues, but states and regions must deal with the reality of implementation and may have many science issues to be addressed. ORD would provide technical expertise where possible, but often regional needs are not met.

NHEERL sees the value of bringing a wider public into discussion of the science generated by the laboratory at an earlier stage in product development and a need for reporting

back to the public on the progress of research. These needs were identified as part of ORD's integrated multi-disciplinary research transformation. There may be potential in NHEERL's working with the International Life Science Institute or the Health and Environmental Science Institute to convene academics, non-governmental organizations, and industry to work with ORD and program offices to help identify common problems and possible research partners. EPA/ORD has also established a more formal working relationship with SOT to advance environmental health research. The Society for Environmental Toxicology and Chemistry and the Pellston conferences can play a similar role for ecological science issues.

NHEERL does focus management attention on feedback provided by divisional reviews. The laboratory made an effort three years ago to identify common threads across all program reviews.

SAB advice sometimes poses problems for ORD. Many SAB reports include multiple recommendations calling on ORD to expand its research activities. There are so many recommendations, ORD does not know how to respond and often extends itself beyond its resources. It may be more useful for the SAB reviews to focus on the granularity needed for different kinds of decision making. EPA should articulate more clearly to the SAB the particular decisions to be made and the Agency's constraints. One area might be how to advance EPA's limited epidemiological knowledge, since it is unlikely that the Agency will have a large budget for major epidemiology studies. It would be helpful to hear practical ideas about how to leverage the work of others or possibly use biomarkers to support environmental decisions.

Meeting with Scientists, EPA Office of Research and Development (ORD) National Health and Environmental Effects Research Laboratory (NHEERL) (11:00 a.m. - 12:30 p.m.)

Participants

Kevin Crofton, Research Scientist
Bob Devlin, Research Scientist
Will Boyes, Research Scientist
Doug Wolf, ALD for Safet Pesticides/Safe Products MYP, Land MYP, Nantechnology, EDCs
Bill Russo, ALD for Water and Land
Bob Hetes, Acting Director, Research Planning and Coordination Staff
Kevin Summers, AD for Science, GED
Wayne Munns, AD for Science, AED
Janet Keough, AD for Science, MEDSAB

NHEERL scientists have developed a process for providing technical support to program offices and some scientists think research and technical support are "intertwined." One NHEERL scientist has spent significant time working with the Office of Transportation and Air Quality (OTAQ) on test rules evaluating fuels and fuel additives and evaluating research plans provided by the American Petroleum Institute that OAR did not have expertise to review. He coordinates through ORD's Office of Science Policy (OSP), which sends the needed technical information to OAR. The Agency's Action Development Process provides a way for ORD to

have input into regulatory decisions. OSP involves the laboratory in review of rules where the laboratory's expertise (e.g., in residual risk or air toxic analyses) would be useful.

On ecological issues, ORD is often asked to play a significant role early in the decision making process (e.g., nutrient criteria, sediment criteria). It also reviews rules after they are developed as well.

The National Ambient Air Quality Standards (NAAQS) review process provides the best example of research planning related to decision making. The NAAQS review process is an iterative process that affects intramural and extramural air research. The new NAAQS process begins a NAAQS cycle with an identification of key policy issues and ends with identification of research needs to inform the next NAAQS review round. The process works well because the NAAQS is predictable. Other programs have much more uncertainty around their long-term issues.

ORD's multi-year planning process has experienced a "paradigm shift." ORD now plans more interactively with program offices so that ORD can anticipate most program office needs. Nevertheless, sudden requests for information happen, for example, when a congressman might write a letter about a specific pesticide (e.g., triclosan), and ORD's research is interrupted to respond to this sudden need for information. Both ORD and program offices need to look at strategic science needs to anticipate the questions that can be informed by ORD research and technical assistance.

Even with careful planning, it is difficult to coordinate research and assessment with program needs for information. Sometimes the timing does not work out.

ORD's transformation efforts focuses on program and regional strategic concerns for information for environmental protection (e.g., as for biofuels or nanoparticles) so that these important concerns receive priority attention. Problem formulation, i.e., identification of the research needed to inform decisions is the principal concern of the transformation effort. Once EPA has identified the decisions it will need to make and the information needed to support those decisions, then the Agency can focus on how to develop or access the needed science.

Requests for technical assistance, whether from a region or headquarters, can vary greatly. Sometimes a request just involves a phone call. At other times, an enquiry can have immediate or long-term research responses. Sometimes a specific technical assistance request can fit into a bigger research question, e.g., a trichlosan question might relate to a broader issue for the endocrine disruptor program or a broader issue about source water threats. ORD does not have a paradigm or single process for handling such requests, though OSP is working to develop such a process with the Regions.

Problem formulation is an important part of the ORD transformation process, but there is no common approach or structured approach. To date, ORD has not used the six-sigma approach, value of information analysis, or a decision-science approach for problem formulation. In general, problem formulation happens informally, with some involvement of stakeholders on issues like biofuels and nanotechnology. One participant noted the potential value of a lifecycle

"source to outcomes" approach to help ORD examine issues rated to fate and transport and target research on the most significant issues.

ORD uses a variety of metrics for assessing its research and is seeking additional useful methods. It currently considers:

- Whether the research made a difference in EPA decision making.
- Whether published literature cites EPA research.
- Feedback from program offices.
- Feedback from the BOSC.

Challenges and barriers to science integration involve:

- Limitation of skills of existing ORD staff .
- Different languages and assumptions of "regulatory scientists" and ORD scientists. Analysts and scientists in program offices want definitive answers; scientists want to communicate uncertainties.
- Difficulties collaborating across ORD laboratories (e.g., problems designing a multi-laboratory facility for biofuels that would house both dynamometers and research animals).
- Difficulties with grant, cooperative agreement, and procurement processes:
    - It is hard for external scientists collaborating with OAR through a cooperative agreement to work with ORD.
    - Grant, cooperative agreement, and procurement processes often move more slowly than the science ORD seeks to develop.
- Peer review processes take so long that it is hard "for EPA to stay on the cutting edge."
- Vast majority of current research is targeted to a single client.
- Some multi-year plans (e.g., sustainability) have no dedicated FTEs, only extramural dollars.
- Limited resources for expanding multi-year plans that are not legacy programs (such as the drinking water program).

Factors that encourage science integration include:

- Leadership that makes science integration a priority.
- ORD Executive Council discussions that encourage science integration across ORD. research programs that are the domains of National Program Directors .
- External advice from the SAB and others focusing on necessary mechanisms for science integration.

Meeting with Director and Management Team, EPA Office of Research and Development (ORD) National Exposure Research Laboratory (NERL)(1:15 a.m. to 2:30 p.m.)

Participants

Larry Reiter – Director, National Exposure Research Laboratory (NERL)
Jewel F. Morris – Deputy Director, NERL
William H. Benson – Acting Associate Directory for Ecology
Linda S. Sheldon – Associate Director for Human Health
Robert S. Dyer – Director, Research Planning and Coordination Staff

EPA has mechanisms to bring Agency needs for research to ORD, mechanisms for ORD to engage these research needs, and processes to report results of research. ORD's mission is to conduct research, provide technical assistance, and provide scientific leadership to EPA. Communication is a component of all three parts of the mission. ORD's research agenda should be on the critical path to address key scientific questions for decision making. It is important for ORD to engage people representing the regulatory perspective in deciding the research to undertake and for ORD researchers to gain understanding of the context of the research in terms of regulatory decisions and policy implications.

Once research is completed, it is the role of the National Program Directors and Assistant Laboratory Directors to communicate research results. National Exposure Research Laboratory (NERL) also has informal interactions with program offices, such as monthly meetings with program office staff, or ad hoc meetings on individual research areas. There is a particularly well-developed dialogue between OPPTS and NERL and between a division of NERL in Cincinnati focused on drinking water contaminants and the Office of Ground Water and Drinking Water.

ORD in general could do a better job in problem formulation by reaching beyond EPA programs and regions to stakeholders. Such efforts would build on the National Research Council report, *Science and Decisions*.

Providing advice and technical support to EPA programs and regions is the second element of ORD's mission. Programs and regions often have needs for specific data or information and would like ORD to have the flexibility to accommodate their needs. Often the desire is for a regional staff person to be able to reach someone in an ORD laboratory or center. For program offices needs, OSP directs queries for technical advice or scientific review to appropriate ORD organizations. NERL has designated an individual to track incoming program queries and identify a NERL scientist to respond. NERL receives 10 to 15 queries per month. Some requests are quickly dealt with; others may require long-term commitment to an Agency work group. Such requests provide an opportunity for scientists to learn about program needs. NERL has been trying to "train offices to go through OSP," rather than contact laboratory scientists individually.

Regions do not understand how often NERL receives requests and how often requests are addressed, because they are "under the radar." One region recently requested the Athens division of NERL (ERD) to measure environmental samples for PCBs in sludge, not a trivial request.

Once the lab provided the results, the region asked the laboratory to measure ground water samples, which required a different analytical method. "Pretty soon the laboratory had four or five scientists on the regional requests," and they were not pursuing their assigned research.

ORD is now implementing a new process for regional requests to come to OSP and be dealt with more systematically. ORD is trying to develop a culture that supports the regions while avoiding requests to individual divisions or laboratories. It may not always be in the best interest of a region for ORD to simply react to and comply with a regional technical assistance request. Often requests come in without a well-developed problem formulation. In the case of PCBs in caulk, a region requested sampling for certain designated schools. ORD entered into a dialogue with the region and OPPTS with the goal of making a conscious decision about managing chemical risks. It is in the region's interest to think through whether the sample to be analyzed is on a critical path for a decision and it is in ORD's interest to see whether the region's request can be linked to one of ORD's priority research questions. ORD needs regions requesting technical assistance to engage in partnership and dialogue around the request. Sometimes, if a regional request involves a standard scientific analysis, ORD can point regions to contractors who can generate reliable information on a routine basis.

For NERL, improved technical support for regions involves more regional engagement in the ORD transformation process, and regional investment of resources in problem identification, prioritization and selection, and problem formulation.

Impediments to science integration include:

- Lack of a culture and formal experience in problem formulation.
- Region calls for expanding the Regional Applied Research Efforts (RARE) grants that leads ORD to lose focus on strategic needs and encourages "job shopping" among ORD scientists.
- EPA managers' reluctance to prioritize among research needs (e.g., the Office of Water has a long list of separate needs for water quality, drinking water, and Office of Wetlands Oceans and Watersheds that could "consume all of NERL."
- Regions as a whole don't work together to identify and prioritize their research needs for ORD.

As an exposure laboratory, NERL does not have the capacity to evaluate a full range of vulnerability factors that includes socioeconomic and geographic variables. ORD is trying to develop some of this capability in its National Risk Management Research Laboratory and through ORD's extra-mural grant program. NERL has made some "small efforts," using geographic information systems (GIS) to examine multiple exposures. One important example is near-roadway air exposures. The GIS system uses census data in new ways for EPA, but does not look at a variety of social factors important to vulnerability. NERL also does not look at behavior and how behavior influences exposure, other than through the Consolidated Human Activity Database (CHAD), which contains data obtained from pre-existing human activity studies that were collected at city, state, and national levels. CHAD data are used as inputs for exposure/intake dose modeling and/or statistical analysis.

The nature of NERL's mission presents some barriers to science integration. Its long-term goal is to provide scientifically sound, easily accessible tools for regions, programs, and scientists to use. The challenge, however, is that there are no surrogate species for human exposures. NERL scientists cannot go into a laboratory to perform human exposure research; they must either go into the field or use models. Epidemiological and other measurement studies are very expensive and the alternative, predictive models, requires very smart choices and astute predictions about how communities and human behaviors will change, thereby changing exposures.

NERL leadership acknowledged that ORD exposure research is a very small part of federal investment in environmental research. On an ad hoc basis, NERL looks for opportunities to coordinate and collaborate with the National Institutes of Health and Department of Energy. EPA also participates in the formal inter-agency science planning efforts of the Office of Science and Technology Policy and the Committee on Environment and Natural Resources Research (CENR).

Meeting with Scientists, EPA Office of Research and Development (ORD) National Exposure Research Laboratory (NERL) (2:45 p.m. - 4:00 p.m.)

Participants

Rochelle Araujo – Senior Research Ecologist, Immediate Office
Rogelio Tornero-Velez – Research Scientist
Kenneth Schere – Research Scientist
Ken Fritz – Research Scientist
Timothy Watkins – Deputy Director, Human Exposure and Atmospheric Sciences Division
Alan Vette – Research Scientist
Meghan Mehaffey – Research Scientist
Valerie Zartarian – Research Scientist
Brad Autrey – Research Scientist

NERL scientists spoke about science integration issues related to their work. Research on air pollution benefits from a well-defined NAAQS process. ORD scientists play an important role in developing Integrated Science Assessments for criteria pollutants and have opportunities to give the Office of Air and Radiation feedback on their Policy Assessment Document. One area for improvement might be for the Policy Assessment Document to include a formal discussion of where to target research in ORD laboratories for future NAAQS reviews. ORD develops EPA's flagship air quality model, Community Multiscale Air Quality (CMAQ) and participates in monthly meetings about the model with OAR users. The pace of NAAQS reviews requires a high level of communication between OAR and ORD so that ORD assessments support the NAAQS schedules.

ORD only seldom receives questions from regions about the CMAQ model. OAQPS is the "first line of defense." Some regions use RARE projects to explore use of CMAQ to inform state implementation plans.

A large number of NERL resources are devoted to NAAQS support and resources are stretched tight. Scientists rely on the Clean Air Scientific Advisory Committee for advice on difficult questions, but has few other resources or mechanisms for accessing the external scientific community.

To stay current in their field, members of NERL's modeling division look for young scholars to participate as fellows through the EPA post-doctoral fellowship program, the ORISE program, or National Research Council fellowship program. Interviewees noted a need for NERL and ORD to do more strategic workforce planning to keep abreast of environmental science and environmental issues. They also noted that NERL has been able to hire fewer new employees as budget cut-backs reduce the FTE ceiling for the laboratory.

Interviewees acknowledged changes in their work as a result of the ORD transformation effort. Scientists are involved more often in multi-disciplinary work and team work. They interact more often with program offices and view their research in the context of the environmental decision making needs. The scientists also acknowledged that graduate schools in public health and schools of natural resources increasingly emphasize multi-disciplinary training and new post-docs and new hires bring this orientation.

Participan ts generally have access to travel funds to interact with a wider scientific community and make use of video, web, and teleconference tools for interacting with other EPA scientists. The only travel restrictions reported were in the Cincinnati NERL laboratory, where field work competes with the travel budget for professional meetings.

External science advice has an impact on NERL's scientific staff. One participant reported that he "finds a lot of review useful and at times painful." Two National Research Council reports (on particulate matter and air quality management in the United States) have been especially insightful and valuable, because it has helped NERL focus on strategic directions. BOSC reviews have also been useful; principal investigators respond to recommendations from BOSC peer reviewers and action items feed into scientists' annual tasks and program development. Another participant spoke of the value of advice from the Scientific Advisory Panel for NERL's collaborative research with the Office of Pesticide Programs.

For ecological research, BOSC and SAB reviews have had major impacts. The goals for the ecological research program shifted five years ago and the program became an ecological services research program. The Ecological Services Research Program has required an "exponential increase" in integration activities across programs and across laboratories.

External review forces scientists to reflect on there programs as they prepare to explain them to outside scientists. BOSC and SAB review call for scientists to engage in the wider scientific community and explain how they serving program offices and meet timelines.

In general, interviewees felt that they had a good balance between long-term research and applied activities. Ideally, there would be no tension and no distinction between the two. Even long-term research for which there is no immediately visible client should be useful to future environmental protection. Participants spoke about the need to allow possibilities for

exploratory research undertaken to prepare for a future need, where there may not be a current client. One example was pharmaceutical research undertaken by a scientist in the National Exposure Research Laboratory before there was a client; now that research is recognized as valuable and the scientist was awarded a gold medal. Similarly, research in sustainability and ecosystem services may be important, but there may be no identified customer at this time and there was no clear client for climate change science in the past administration, so ORD laboratories invested minimal resources in those activities.

Interviewees noted that there is no effective program to enable exploratory research. In the past, ten percent of resources were devoted to exploratory work, but budget cuts have made that a luxury. The multi-year planning process is a top-down planning model. If there areas for exploratory research within a laboratory, they are generally supported by management, but there are negative consequences for researchers pursuing a risky path.

The last part of the discussion concerned the increased burden of work of ORD scientists who now are expected to stay current with their science, publish meaningful work, coordinate across programs, disciplines, and laboratories, and communicate scientific results to programs and regions. The demands "add to everyone's plate across the board." There are processes, however, that help scientists cope with these demands. Collaboration, for example, with the Office of Pesticide Programs (OPP) relies on processes that help scientists understand OPP's products, needs, and timelines. ORD and OPP scientists work in small workgroups on common projects, hold monthly and bi-weekly meetings, and have assigned clear responsibilities for a common project. OPP's has many cyclical processes that allow ORD to learn OPP's culture and needs. Some other programs have less-well-defined mandates, no review cycle or organizing framework, and as a result do not offer ORD an easy framework for collaboration.

EPA Office of Research and Development (ORD) National Homeland Security Research Center (NHSRC) Science Integration for Decision Making Fact-Finding Interviews
November 30, 2009
Washington, DC

Three members of the SAB Committee on Science Integration for Decision Making interviewed the Acting NHSRC Director and Staff: Drs. Gary Sayler and Thomas Theis in person and Dr. Jill Lipoti, by phone. Dr. Angela Nugent, Designated Federal Office for the committee, provided a brief introduction to the purpose of the interview. She also took notes to develop a summary of the conversation. All interviewees were provided a copy of the committee's Preliminary Study Plan in advance.

Dr. Nugent noted in each interview that the purpose of the interview was to help SAB Committee members learn about the NHSRC Program's current and recent experience with science integration supporting EPA decision making so that the SAB can develop advice to support and/or strengthen Agency science integration efforts. Dr. Nugent thanked participants for taking time for the interviews.

Interview with NHSRC Managers and Staff

Participants:

Dr. Cynthia Sonich-Mullin, Acting Center Director
Mr. Jonathan Herrmann, Center Director (on Special Assignment)
Dr. Gregory Sayles, Acting Deputy Director for Management
Mr. Kim Fox, Division Director, Water Infrastructure Management Division
Dr. Tonya Nichols, Acting Division Director, Threat and Consequence Assessment Division
Dr. Hiba Ernst, Acting Division Director, Decontamination & Consequence Management Division
Dr. Shawn Ryan, Associate Division Director, Decontamination & Consequence Management Division
Ms. Kathy Nickel, GPRA Coordinator, Immediate Office, NRSRC
Dr. Kevin Garrahan, Acting National Program Director, Threat and Consequence Assessment Division

The Acting Director began the discussion by noting that the National Homeland Security Research Center (NHSRC) develops all its research to support EPA's homeland security mission and designs its activities in light of customers' needs. The goal is to provide solutions to problems their customers face in the near term. Sometimes, however, problems arise in translating "what the customer thinks is needed" into research.

The NHSRC organization reflects EPA's four major homeland security missions. Where there is a security incident, EPA helps clean it up. EPA is the sector lead for drinking water and waste water (but not harbors)

SAB members asked about the Center's decision strategies about when to release tools for use. The center follows ORD quality assurance procedures, but if the center can provide information useful to internal customers, they make the information available with the proviso that "this is what we know right now." They try to communicate uncertainties associated with products "transparently and fully." They collaborate with partners in development of assessments (e.g., provisional advisory levels that provide acute exposure guideline levels) and products and try to release information and products as early as "responsibly possible." In the water program, for example, water utilities and consultants were partners in developing the Threat Evaluation and Vulnerability Assessment (TEVA) tool. The Office of Water is piloting TEVA. The NHSRC is working with commercial developers and its customers in an iterative way to complete the tool. The decontamination program uses a similar approach. Researchers work with customers who would use scientific or technical tools. As they "understand better issues users face," researchers further develop tools.

Clients sometimes want a "quick and dirty test." In those cases, it is especially important that clients read and understand the limitations and uncertainties of scientific tools. NHSRC scientists know what level of detail is appropriate to share in semi-protected environments, in one-on one communications with individuals who have with security clearances. This information is different from information to share with contractors and the public.

Managers noted that such a strategy for releasing scientific tools for homeland security needs requires merging traditional EPA science with social and behavioral science. They acknowledged a challenge in managing EPA's workforce, given limited opportunities for workforce expansion. One manager noted that this is "an awkward area for us" since ORD dropped out of social science and economic research in the 1980's. The NHSRC is bringing those disciplines back in a limited way. NHSRC hasn't hired permanent staff with expertise in social and behavioral sciences. Instead, three members from the center maintain "intensive interaction with the disaster community" through the Office of Science Technology and Policy Committee on Disaster Reduction. This interaction helps the center tap the committee's social science base. NHSRC has also sponsored AAAS fellows with expertise in social science; they have sponsored a sociologist, a systems analyst with interest in decision making and risk perception, and currently, an anthropologist. NHSRC hopes that interaction with these fellows and the broader social science community will help ORD determine what it can do in the social and behavioral science arena to advance the homeland security research mission. NHSRC is also working with the National Center for Environmental Research on a small grant to sponsor social science research in a "half dozen" areas suggested by the SAB Homeland Security Advisory Committee related to non-zero clean-up levels for biologicals. NRSRC anticipated an announcement of this grant in late December 2009 or early 2010.

One manager asked SAB members to explain in more detail the SAB's interest in social and behavioral science. Members responded that risk communication, public perception of risk, and a structured approach to decision science might help the center communicate about its tools, prioritize tools, and help users employ them.

Managers described efforts to expand the Center's expertise, given limited authority for new hires. The center has made use of Federal post docs, ORISE post-docs, and AAAs fellows.

The center also funds training and full degree programs to encourage scientists to broaden their expertise. It is a benefit that their center is "young." Staff were attracted to the center's mission after 9/11. The scientists are mission-driven and seem to be more flexible and interdisciplinary than most ORD scientists. The culture in the center is to conduct mission-driven research, not "legacy research." Managers are thinking ahead to succession planning in anticipation of upcoming retirements. They consider each new hire in light of the overall staffing needs for the center. Managers also acknowledged that their fairly flat organization has made them more nimble and acknowledged their relatively large extramural budget, compared to many other parts of ORD.

The center makes plans for the future based on three priorities: 1) Administration-identified priority threats (e.g., currently biothreats, dirty bombs); 2) NHSRC's own fact finding; and 3) program customers and stakeholders. The center tries to balance long and short-term research needs.

When asked for impediments to interdisciplinary research, managers noted that often, despite efforts to interact with customers and develop products through partnerships, customers hesitate to use science or tools developed by the center. NHSRC managers acknowledged that NHSRC scientists often underestimate the time needed for "science translation, i.e., communicating how research results can actually impact EPA's environmental protection work. They noted that this problem is a common one for ORD and is, in part, one focus of ORD's transformation effort. One lesson learned is that potential clients must be ongoing participants in development of a science product, starting with joint development of a Quality Assurance Program Plan that captures the research objectives in writing, so that both ORD and the customer have a common understanding of who would use the product and for what purpose.

An SAB member asked whether the NHSRC involves environmental groups or stakeholders developing products, such as tools to identify non-zero cleanup levels. Center managers responded that they viewed the Agency program offices and regions as their primary customers and are committed to "walking in their shoes." They view environmental and stakeholder groups as the next tier, appropriate to provide comment in the peer review stage. NHSRC delivers products to customers, who then "take the science products to environmental outcomes" and deal with stakeholder in setting non-zero levels. They anticipated problems if environmental groups became involved with the development of "pure science products."

Another impediment to the center's work is users' reluctance to engage with uncertainties associated with the release of center products. There are often 40- or 50-page quality assurance and peer review reports associated with products, but users, such as on-scene disaster coordinators, who are called upon to make decisions quickly, do not want to deal with such detailed information. "The more information they have, the less they like it." It is challenging to communicate the answers to the exact questions on-scene coordinators raise and to do it briefly in ways that support their needs. One example was a region's need to decontaminate raw drummer skins from Africa that contained anthrax. Region 1 was able to use a preliminary NHSRC decontamination method that used chlorine dioxide, but that method would not necessarily work in situations where temperatures and other factors differ. Communicating these complexities can be difficult.

NHSRC scientists must walk a fine line. They are not in a position to make Agency policy on homeland security, but they need to interact and communicate with policy makers to understand their research needs.

Managers touched on several other impediments. They noted that the Department of Defense (DOD) and the Department of Homeland Security (DHS) often do not inform EPA appropriately about research planning and do not collaborate, even when DOD and DHS target research on EPA's priorities. Managers also noted that the NHSRC does not own laboratory space; instead, it shares laboratories with other parts of EPA.

Center managers noted some "drivers" encouraging science integration. The center's mission focus has weaned it from a more traditional academic focus. Center managers take note of customers' feedback and have stopped academically acclaimed projects that were not useful to client offices. They viewed this decision as a success for the program. Center managers also said that views by the Board of Scientific Counselors, the National Research Council, and the Science Advisory Board suggested new ideas that have improved the program and enhanced its credibility. One manager noted that preparation for these reviews are useful education efforts for center staff and encourage cross-program dialogue. Preparation for the reviews helps the staff tell the story of their research and communicate why it is valuable. It helps staff see where their research fits into the big picture.

One manager voiced some frustration with the SAB's Homeland Security Advisory Committee's strong criticism of the center's limited ability to enhance its capabilities regarding risk perception and risk communication. He acknowledged that public risk perception is an important issue to address, but viewed this issue as a government-wide issue with strong involvement needed by the Department of Homeland Security.

Managers then spoke briefly about methods for characterizing uncertainties. Managers noted that they do use models and guidance provided by the Center for Regulatory Environmental Models. The principal barrier to use of the models is communication of uncertainties.

EPA Office of Research and Development (ORD) National Risk Management Laboratory (NRMRL) Science Integration for Decision Making Fact-Finding Interviews
November 30, 2009
Cincinnati, OH

Two members of the SAB Committee on Science Integration for Decision Making, Drs. Gary Sayler and Thomas Theis interviewed the Director and Staff of the NRMRL. Dr. Angela Nugent, Designated Federal Office for the committee, provided a brief introduction to the purpose of the interview. She also took notes to develop a summary of the conversation. All interviewees were provided a copy of the committee's Preliminary Study Plan in advance.

Dr. Nugent noted in each interview that the purpose of the interview was to help SAB Committee members learn about the NRMRL Program's current and recent experience with science integration supporting EPA decision making so that the SAB can develop advice to support and/or strengthen Agency science integration efforts. Dr. Nugent thanked participants for taking time for the interviews.

Participants:

Ms. Sally Gutierrez, Director
Dr. Andy Gillespie, Deputy Director for Management
Dr. Herb Fredrickson, Associate Director for Ecology & EDC
Dr. Subhas Sikdar, Associate Director for Science
Dr. William Schuster
Dr. Marc Mills
Ms. Joyce Walling

SAB committee members asked the NRMRL director to begin the discussion by describing how she decides the focus of her program, given its broad mission, and where science integration fits into the picture. The director noted that the biggest environmental issues arise in the context of sustainability, but a focus on sustainability is new and different from EPA's structure and mandates. Her biggest challenge is to build a solid research program to support sustainability and to build consciousness about sustainability issues, when there are no decision makers charged expressly with that mission. Water resource management, land use, and climate change are all parts of EPA mission and should be viewed in the context of sustainability, but rarely are viewed in those terms. There is a need to inform and educate the managers in EPA's busiest programs about the significance of sustainability, so that they can engage in discussions about sustainability with decision makers in the private sector and stakeholders who have adopted sustainability as a central way of viewing environmental issues.

Other managers underscored the challenge involved in providing science to support sustainability decisions. Sustainability decisions are necessarily multi-media, but EPA is organized to enforce statutes, and the formal organizational structure has air, water, and land program areas. Sustainability thinking requires cutting across program silos.

NRMRL managers devote attention to brainstorming ways to make change happen and overcome inertia. One strategy might be to interact directly with stakeholders, who "live in the

real world," unconstrained by EPA's organizational structure. ORD might bring them into research decisions and work with them as a vehicle to effect change at EPA. NRMRL managers see potential in interacting with "problem owners," for example, owners of water systems affected by aging water infrastructure, and seeking partnerships to work on the science necessary to solve their management problems. Other examples where NRMRL took this approach include:

- Research activities involving a Researcher who is an architect who worked with a community in Stella, Missouri, where there was concern about the communities' long term sustainability as the area around the Walmart headquarters expands;
- A decision-support tool for managing municipal solid waste;
- Technical support centers for Superfund problems at individual sites.
- Planning for stormwater management in Cuyahoga County, which incorporated green Best Management Practices that included a park structure that provided ecosystem services.
- A Cooperative Research and Development Agreement (CRADA) with Louisville for wet weather flow and green infrastructure.
- Asustainability study conducted in collaboration with Region 8 for Colorado.
- A Cincinnati sustainability study in the Shepherd's Creek.

These customer-oriented efforts build upon NRMRL's history supporting EPA client offices. NRMRL has a supported the Office of Air and Radiation, for example; one prominent example is research supporting the Clean Air Mercury Rule.

NRMRL managers described their efforts to build expertise in sustainability science. The NRMRL director noted that every new hiring decision requires consideration of the lab's strategic human resource needs. She identified specific needs for expertise in modeling and decision sciences and described the difficulties of making informed hiring choices in technical areas new to the laboratory (e.g., decision science). Other managers cited the progress NRMRL has made in hiring in new areas of expertise: law, systems ecology, and economics. Managers make efforts to hire post docs and to retrain experts who are flexible and willing. Decisions to hire post docs are made at the laboratory level, rather than by Principal Investigators, so that new personnel benefit the whole laboratory, not just a single research effort. NRMRL also makes use of the temporary government employee mechanism used actively by the Ecosystem Services Research National Program Manager. This mechanism allows the laboratory to explore new areas of expertise to see where the laboratory might make a significant investment.

Managers described barriers to integration. Risk management is often regarded as the last link in the risk paradigm and historically has received meager resources. Managers suggested that a sustainability paradigm involves thinking of management early in the scientific process. One example suggested was the challenge of mercury in fluorescent light bulbs. Instead of NRMRL investing in research to develop less toxic light bulbs or clean-up programs for broken or discarded light bulbs, the laboratory could invest in research and design so buildings maximize daylight. How decision makers frame questions determines the needed science and EPA needs to interject sustainability questions early in risk management discussions.

Managers spoke of the challenge of sustaining interdisciplinary collaboration. NRMRL has three major integrated efforts: watersheds, biofuels, and nanotechnology. For these issues, NRMRL is not often at the table for major policy discussions. Without advanced research planning for sustainability, however, EPA will find itself in "catch-up" mode, developing remedies for an environmental problem.

Although program offices have not partnered with NRMRL on sustainability projects, the laboratory has partnered with the Army Corps of Engineers on a sustainability project in the Ohio River Basin. NRMRL has the ability to work with stakeholders at the grass roots level on major development issues and to contribute research for problem solving.

The NRMRL managers acknowledged that their successful projects were "small programs under the radar." Scaling up projects in partnership with the Office of Water and Office of Air and Radiation would require significant resources and may encounter challenges from within EPA.

SAB members asked how NRMRL gathers and responds to feedback about science. NRMRL primarily relies on ad hoc feedback, although it meets regularly with program offices. Program offices review NRMRL's research plans and react to products developed. The laboratory has a system for reviewing its 21 major research areas according to criteria in the strategic plan. Reviews have lead to decisions to disinvest in certain areas. In addition, scientists interact with "problem holders" to identify needs. They conduct gap analyses within the framework of the NRMRL strategic plan. They work to fill the plans needs and meet stakeholder needs.

Field studies are resource-intensive. Projects that require stakeholder interaction require travel budgets for reaching out to stakeholders.

A NRMRL scientist described a major field study that addressed a well-defined stressor and involved social, economic, and environmental concerns. NRMRL's Sustainable Environment Branch focused on storm water as a major national issue that offered an opportunity to integrate law, economics, ecology, and hydrology. They aimed to manage risks caused by excess storm water in an urban and suburban context. They tested an auction-based approach which engaged stakeholders in new ways to manage this significant problem. The research offered a practical solution of interest to a diverse set of stakeholders in the Shepherd Creek Watershed.

NRMRL managers and staff proposed that the approach could be used in other mid-west cities and could be adopted as part of consent decrees. NRMRL is working with city of Cleveland to take wide variety of decision tools to use vacant land and assign to non-traditional land use that provide-ecosystem services (e.g., storm water abatement, esthetics). Managers noted that there are also human health benefits of interest to Agency managers, so that the approach may be attractive to EPA senior managers. NRMRL is in the process of documenting benefits and environmental improvements. When that research is completed, the project will be "promoted more" and may receive fuller support from across ORD and the Agency.

Another scientist described NRMRL multi-disciplinary research addressing contaminated sediments. It began initially in 2002 as a relatively small project evaluating a Superfund remedial method by addressing the difference between a Superfund Remedial Project of reduced sediment and reduced toxic levels in fish tissue. NRMRL engineers reached out to fish tissue and sediment experts and over time realized that the goal of the research evolved from a focus on a particular remedial method to a broader question of how to assess remedy effectiveness. The project was "low profile" and initially benefited from Superfund research funds, but the Superfund process offered too slow a timeframe for the research envisioned by NRMRL. NRMRL then found a new customer in the Great Lakes National Program Office (GLNPO), which had received funding to conduct legacy act remediation. NRMRL worked with GLNPO on methods to evaluate remedy effectiveness and methods to evaluate program effectiveness,

SAB members and NRMRL managers and staff discussed the merits of "working under the radar." Such projects allow scientists to build a team based on trust and collaborate in creative ways, but if a project is successful, it needs to be shared with a larger community.

SAB Science Integration for Decision Making Fact-Finding Meeting
Office of Research and Development, Office of Science Policy
EPA West, Washington, DC
January 28, 2010

Four members of the SAB Committee on Science Integration for Decision Making conducted an interview in EPA's Office of Research and Development (ORD), Office of Science Policy (OSP): Drs. James Johnson and Gary Sayler conducted the interview in person, and Drs. Terry Daniel and Thomas Theis participated by telephone. Dr. Vanessa Vu, Director of the SAB Staff Office, provided a brief introduction to the purpose of the interview and the Designated Federal Officer, Dr. Angela Nugent, took notes to develop a summary of the conversation. All interviewees were provided a copy of the committee's Preliminary Study Plan in advance.

Dr. Vu noted that the purpose of the interview was to help SAB Committee members learn about OSP's current and recent experience with science integration supporting EPA decision making so that the SAB can develop advice to support and/or strengthen Agency science integration efforts. Dr. Vu thanked participants for taking time for the interviews.

Meeting with the Office of Research and Development (ORD), Office of Science Policy (OSP) (January 28, 2010, 3:30 p.m. - 5:00 p.m.) Participants:

Dr. Fred Hauchman, Director
Ms. Mimi Dannel, Acting Deputy Director
Dr. Bruce Rodan, Senior Science Advisor
Mr. Robert Fegley, Acting Program Support Staff Chief
Dr. Nigel Fields, Regional Staff Chief
Dr. Ronald Landy, Previous Regional Staff Chief

The Office of Science Policy (OSP) is one of four ORD offices in Washington, D.C. It assists the ORD Assistant Administrator with high priority, urgent issues. It has three staffs: a Program Support Staff, a Regional Science Program Staff, and a Cross-Program Staff.

The Program Support Staff is involved with all of EPA's major regulatory issues and has a land team, water team, and air team. OSP representatives participate in EPA's Action Development Process and sit in on discussions of all Tier 1, most Tier 2 and some Tier 3 actions depending on the likelihood that science issues will be addressed in the action. The Program Support Team also responds to congressional enquiries and provides technical information when requested by EPA's Office of Congressional and Intergovernmental Relations.

When issues are identified, OSP involves staff from across ORD, as appropriate, and represents ORD's corporate view in the Action Development Process. One example is OSP's role in recent activities involved in mountaintop mining. OSP staff know the science issues, are "politically savvy," are clear communicators, and have diplomatic skills. They involve ORD laboratories and centers in priority issues and mediate among them to represent ORD's views.

OSP staff provide ORD's political leadership their best scientific judgment on topics, realizing that "at the end of the day, decisions are made by EPA's political leadership." Scientists provide their honest views and characterization of uncertainties. Science is always considered in senior-level meetings when there are science issues, though there are some policy decisions that are not science-based. During the Action Development Process, the lead program office typically develops and delivers a briefing to the decision maker. The Administrator (for Tier 1 actions) asks for input from all offices attending the briefing before she makes a decision. She is especially interested in knowing the major areas of controversy and uncertainty.

A barrier to science integration is the limited time to discuss complex science. Decision makers are busy, and some subtleties can get lost unless there is sufficient time to fully communicate the uncertainties. The best communications involve ongoing conversations, where scientists communicating a complex issue get feedback that helps them understand when they are communicating effectively about these uncertainties.

OSP generally does not interact with the public, although ORD does participate in public meetings to discuss scientific issues associated with important programmatic/regulatory activities. For example, many years ago, ORD was heavily involved in supporting the Office of Water in the development of the Microbial/Disinfection Byproducts (M/DBP) Rule. The M/DBP Rule was developed through a negotiated rulemaking process that involved extensive discussions with stakeholders about the use of ORD science.

ORD's Regional Science Program Staff supports regional Superfund and Technical Liaisons (STL) and Regional Science Liaisons (RSL). The STL in each region is charged with bringing ORD science to regional Superfund programs and identifying regional needs. The RSLs address broader science issues and serve as liaisons between their region and ORD. The RSLs are responsible for managing the programs described below. ORD pays the salaries for the RSLs, but they are regional employees

OSP is involved with ORD's efforts to strengthen relationships with regional scientists. OSP administers the $2 million/year Regional Applied Research Effort (RARE) Program and the Regional Methods (RM) Program. These two programs are specifically designed to address the high priority, targeted and immediate research and analytical methods needs of the regions. OSP sponsors the regional workshop series on emerging science issues. It supports RSLs in managing the Regional Research Partnership Program, which offers regional scientists the opportunity to work with scientists in ORD laboratories/centers on research projects of interest to the regions. All these programs, though limited, have been successful. OSP acknowledged that they could publicize the benefits and outcomes of the programs more effectively.

It has been challenging to involve the regions in ORD's research planning process. High transaction costs are barriers to meaningful involvement and the many regional needs far outstrip ORD resources. OSP relies on RSLs, National Program Directors, ORD Laboratories and Centers, and ORD programs to coordinate with regions in ORD's planning process.

Often regional needs for research results involve a completely different timeframe than ORD research. Regions need science to solve immediate problems or problems within a one-

year window. ORD research can have a five-year or longer horizon. As mentioned above, the RARE and RM programs are designed to help address this issue.

One OSP interviewee distinguished between research (the creation of new knowledge) and science (the organization of knowledge or information together in a logical framework). ORD is EPA's research organization; there are scientists throughout EPA.

Sometimes ORD can offer the "full spectrum" of what regions need: research results and technical support. If regions have a priority need, there is a process to identify it and submit it to OSP. OSP will "pull people together" in response." One example is OSP's role in recent activities involved in mountaintop mining. OSP followed this issue and drew ORD's National Center for Environmental Assessment into the discussion. OSP, however, has not documented the percentages of the universe of requests from regions that go unanswered. There was a general sense, however, that "often regions want something different than what ORD can offer."

ORD's Executive Council has recently discussed the issue of regional technical support. ORD managers have the general sense that currently ORD scientists spend a significant amount of time responding to regional needs for support. There may be a need for OSP to work with the lead ORD region and build on past experience with the ORD Regional Science Summit to develop a consolidated list of highest priority regional issues.

In the past, EPA had a national regional science council, but that organization no longer exists. Although the ten regions have a set of common needs, each region has unique needs because of their history and geography.

OSP's Cross Program Staff has the responsibility for the development, coordination and oversight of office-wide strategies for ORD involvement in issues that cut across EPA's traditional program-specific emphasis. Primary activities include support for ORD's Board of Scientific Counselors, Environmental Justice, the Federal Technology Transfer Act program, the Tribal Science Program, and multi-media efforts, including international activities.

EPA Office of Research and Development's National Program Directors and Program Leads
Planning and Standards Science Integration for Decision Making Fact-Finding Interviews
February 4, 2010

Three members of the SAB Committee on Science Integration for Decision Making conducted an interview with the Office of Research and Development's National Program Directors and Program Leads via teleconference: Drs. Rogene Henderson, Wayne Landis, and Thomas Theis. Dr. Anthony Maciorowski, Deputy Director of the SAB Staff Office, provided a brief introduction to the purpose of the interview and the Designated Federal Officer, Dr. Angela Nugent, took notes to develop a summary of the conversation. All interviewees were provided a copy of the committee's Preliminary Study Plan in advance.

Dr. Maciorowski noted that the purpose of the interview was to help SAB Committee members learn about National Program Directors' and Program Leads' current and recent experience with science integration supporting EPA decision making so that the SAB can develop advice to support and/or strengthen Agency science integration efforts. Dr. Maciorowski thanked participants for taking time for the interviews.

EPA National Program Directors' Perspectives (2:00 p.m. - 3:00 p.m.) Participants:

EPA Office of Research and Development National Program Directors and Program Leads:

Dr, Stan Barone, Human Health Risk Assessment
Dr. Dan Costa, Air
Dr. Sally Darney, Human Health
Dr. Elaine Francis, Pesticides and Toxics
Dr. Kevin Garrahan, Homeland Security
Dr. Alan Hecht, Sustainability
Dr. Rick Linthurst, Ecosystem Services
Dr. Randy Wentsel, Land

Although ORD has a structured research planning process, there is flexibility to respond to emergency issues and immediate regional priorities. A prime example is ORD's response to the aftermath of Hurricane Katrina. ORD and other offices responded quickly and were even able to request SAB advice and review. When a human health risk assessment issue emerges (e.g., lead in drinking water in Washington D.C., air risks associated with the World Trade Center disaster, PCBs in caulk), regions or states may have exposure data. ORD typically will conduct a screening-level assessment or develop a preliminary assessment. ORD scientists have responded to a Region 4 call to evaluate acute risks related to perflourinated chemicals. ORD scientists' response, however, come at a cost to previous commitments made. EPA's human health research program has historically focused on long-term core research, but the current Administrator has asked that immediate problem-specific issues also be addressed.

There are mechanisms to integrate the newest science into EPA's research programs. ORD's air research has a "constantly ongoing process" for re-evaluating criteria pollutants. The National Center for Environmental Assessment has a new publication inventory process that will help keep assessments up to date. ORD itself creates much of the emerging science related to air pollution. Methods development can be difficult, but ORD scientists quickly incorporate new scientific approaches.

ORD human health science also pioneers in integrating new approaches into Integrated Risk Information System (IRIS) assessments. ORD uses new physiologically-based pharmacokinetic (PBPK) regression modeling and other new analytical techniques into chemical assessments. Draft assessments are peer reviewed before they are used by regions, states, and programs.

To keep up with new science and methods, ORD uses a variety of approaches. There is a need for continuous cross-training for EPA scientists in new methods, such as life-cycle assessment. ORD has a limited number of staff with social science expertise, so the Ecological Services Research Program uses innovative methods to consult with external scientists, for example using Special Government Employees to get the expertise it needs. The Human Health research program relies on grants programs to access expertise in epidemiology, children's health, and community stressors. EPA, however, cannot legally direct grantees to provide information of particular benefit to the Agency. Several research programs (e.g., Global Change, Air, Human Health) have extramural grants programs; others do not.

There are generally few obstacles to integrating new science into ORD research. In contrast, there are obstacles to implementing new science into EPA programs and decisions. Lifecycle analysis, for example, is required by mandate only for greenhouse gases. It is not required and not conducted for decisions in other programs. Similarly, it is difficult to integrate computational toxicology approaches into the pesticide and toxics programs. There is a sense that the new science must be "solid enough before it moves a policy forward." If the science is controversial, it is difficult for decisions to be made using it.

EPA's regulatory mandates and institutional "stovepipes" create barriers to science integration. Reform of the Toxic Substances Control Act is timely and may provide a new regulatory paradigm for human and ecological health assessment.

ORD monitors international research related to its major research programs. The computational toxicology program is distinctive for its involvement with international organizations. There is significant international exchange on air pollution research. ORD researchers sit on the World Health Organization Board and international researchers sit on the Particulate Matter Centers Review Board. ORD researchers interact often and collaborate with scientists from other countries through the Organization for Economic Cooperation and Development.

ORD has multiple effective mechanisms for receiving and addressing feedback on its research. The ORD Board of Scientific Counselors provides feedback on each research program

on a periodic basis. Program offices provide feedback. Inter-agency review of technical documents allow for feedback from other federal agencies on major ORD work products.

ORD's ecological programs receive peer review on individual work products, but lack a mechanism for integrating multiple "pieces of the ecological analysis puzzle together" in an overall assessment that will have meaning for decision makers. ORD ecological assessments do not yet have the same overall integrative power as ORD human health assessments. One recent effort to conduct such a major assessment is the National Center for Environmental Assessment's Integrated Science Assessment for Oxides of Nitrogen and Sulfur, which examined ecological and welfare effects.

ORD has explored possible integration of human health and ecological sciences. One important area is climate change, where human health and ecological effects need to be studied together. The concept of ecosystem services, which includes human well being, offers an opportunity to integrate information about human and ecological impacts. ORD representatives plan to meet with officials from the Centers for Disease Control (CDC) in April to discuss accessing CDC databases that can shed light on both human and ecosystem exposures and other issues. The endocrine disruptors program is also trying to integrate human health and ecological research. There may be a possibility of developing tools to extrapolate across species because the "endocrine system is well conserved across vertebrates" and molecular tools may be useful both for understanding the degree of similarity in some human health and ecological effects.

There seems to be more continuity in EPA's science than in policies and politics at the Agency. The endangerment finding changed EPA's climate change program and responsibilities in major ways. To anticipate future changes in policies, ORD tries to have well considered research plans that incorporate input from multiple stakeholders and advisory panels that will be sustained through different Administrations.

To meet the needs of emerging environmental problems, EPA may as a whole need to conduct an analysis of current workforce vis à vis emerging environmental problems. It would be helpful if ORD engaged in a workforce planning process that was focused, well-conducted, and efficient. ORD has an aging workforce that as a result of retirement is losing effectiveness and new hires that may not necessarily have the experience or training to accomplish needed research in all areas. EPA's post-doctoral program is reasonably successful, but EPA cannot rely only on post-docs to provide the key new expertise needed for the Agency.

SAB Science Integration for Decision Making Fact-Finding Meeting
Office of Policy, Economics, and Innovation, National Center for Environmental Economics (NCEE)
Ariel Rios North, Washington, DC
January 21, 2010

Four members of the SAB Committee on Science Integration for Decision Making conducted one interview with EPA's National Center for Environmental Economics (NCEE): Drs. Terry Daniel and Thomas Wallsten in person, and Drs. Catherine Kling and Thomas Theis by telephone. Dr. Vanessa Vu, Director of the SAB Staff Office, provided a brief introduction to the purpose of the interview and the Designated Federal Officer, Dr. Angela Nugent, took notes to develop a summary of the conversation. All interviewees were provided a copy of the committee's Preliminary Study Plan in advance.

Dr. Vu noted that the purpose of the interview was to help SAB Committee members learn about NCEE's current and recent experience with science integration supporting EPA decision making so that the SAB can develop advice to support and/or strengthen Agency science integration efforts. Dr. Vu thanked participants for taking time for the interviews.

Meeting with the NCEE Director and Technical Staff (9:15 a.m. - 10:15 a.m.) Participants:

Dr. Albert McGartland, Director
Dr. Charles Griffiths, Economist
Dr. David Evans, Economist,
Dr. Elizabeth Kopits, Economist
Dr. Nathalie Simon, Economist
Mr. Daniel Axelrad, Environmental Scientist

The National Center for Environmental Economics (NCEE) is part of EPA's Office of Policy, Economics, and Innovation. It contains EPA's largest concentration of economists and also includes experts in human health science and ecology. NCEE provides technical economic support to program offices, reviews economic analyses for economically significant rules, and engages in primary research to fill key information gaps for economic analysis. NCEE analysts bring a deep knowledge of risk assessment and an interdisciplinary skill set to benefits analysis. The Center has a strong interest in advancing new and better ways to quantify benefits and costs associated with EPA's regulatory options.

Activities vary depending on Agency priorities, but approximately half of NCEE's time is devoted to regulatory review, primarily to support activities related to climate change and EPA's Office of Air and Radiation. Typically, individual program offices conduct economic analyses independently and then provide those draft analyses to NCEE for review. Ideally, EPA’s program offices would consult with NCEE early in the regulatory process about the design and execution of economic analyses, when the center could be most helpful. Program offices most often reach out to NCEE in the early stages of analytic development when a program office manager is knowledgeable about the need for economic analysis, does not have the in-house capability to perform the analysis and/or encounters a particularly difficult problem (e.g.,

benefits assessments for air toxics). NCEE may also be called in to help when there is a new use for or understanding of the use of economic analysis, for example, as with the April 2009 Supreme Court determination that EPA acted reasonably in weighing the costs and benefits of various technologies when it promulgated regulations for cooling water under Section 316(b) of the Clean Water Act.

NCEE also tries to look across EPA analyses to identify key data and knowledge gaps that can be the focus of research. One example is NCEE's current interest in improving cost analysis, so it will have rigor comparable to EPA's benefits analysis.

Integration across scientific disciplines is essential to research in environmental economics, just as it is essential to any individual economic analysis. Ideally, problem formulation would happen at a high level or systems level before scientific analyses begin, with social scientists, including economists, at the table. Often NCEE economists encounter biologists and chemists who apply standard tools that do not address risk managers' issues or issues of human behavior -- questions of interest for economists. Recently, there has been some increased collaboration between human health scientists and economists in program offices, but regional offices generally do not have regulatory requirements for formal benefit analyses that can help foster such inter-disciplinary collaboration.

Economists bring a different perspective to scientific analysis compared to other EPA scientists and have persisted in raising questions not pursued by EPA risk assessors. One example is non-cancer health effects, such as hypertension effects related to mercury exposure and cardio-vascular impacts of ozone. NCEE suggested including those endpoints in EPA's benefit assessment because information relevant to risk management existed, although they were not included in the final analysis.

It has been difficult to communicate uncertainty to EPA decision-makers and the public. Both groups - and EPA's press office - typically do not want a probability density function and ask instead for an uncertainty range or for a "middle number." A recent report by Resources for the Future (Krupnick, A.J., R.D. Morgenstern, et al. 2006, *Not a sure thing: Making regulatory choices under uncertainty*) contains a useful appendix on communicating uncertainties, but NCEE staff still are seeking new approaches. One interviewee reported that qualitative discussions are generally more successful than quantitative discussion. NCEE is experimenting with graphical representations of uncertainty to communicate the benefits of climate change actions.

Integration of uncertainty information into decision making depends on the political or policy context. If there is a bias against regulatory action, uncertainty information can become an "excuse not to do anything," rather than an acknowledgment of some probability greater than zero. Similarly, economists may be "pushed out of the picture" by managers with a bias towards action, if economists are perceived as "slowing down the regulatory process." SAB members suggested that the scientific process may not fit well with many of EPA's regulatory programs, where there are disincentives to revisit hard-won regulations. Previous recommendations about some aspects of science integration may have ignored this "mismatch." An adaptive management model for integrating science and policy might fit better with EPA programs that

have an iterative component, like the National Ambient Air Quality Standards program, which requires review of criteria air pollutant standards every five years.

In the remaining part of the discussion, NCEE staff discussed science integration related to different kinds of analyses supporting environmental protection.

- Market-based tools are being explored by different parts of EPA (e.g., EPA's Office of Water has a dedicated team of 4-5 people dedicated to offsets and tradable permits), while NCEE has focused on the need to design such tools well and has offered suggestions where it believes market incentives will or will not work well.
- For ecological valuation, NCEE is open to alternatives to monetizing if such approaches would help inform decisions. Wetland indexing and an ecosystem-service approach could help decision makers, for example. NCEE is critical of methods, that rely on metrics that are not based on metrics linked to environmental benefit (damage) or appropriate value. An example of a metric NCEE does not favor is the "emergy concept."
- EPA will need the capability of analyzing trade-offs between potential changes in different kinds of ecological services.

NCEE concluded the discussion by underscoring the importance of stated preference surveys as a mechanism for understanding public preferences and integrating that information into decision making. EPA should conduct and make use of scientifically valid studies of public preferences, independent of politics and changes of Administration. NCEE itself does not generally participate in any other kind of interaction with the public in developing scientific assessments, other than to participate in conferences or public meetings of the Science Advisory Board Environmental Economics Advisory Committee, where many NCEE work products are reviewed.

SAB Science Integration for Decision Making Fact-Finding Meeting
Office of the Science Advisor
Ronald Reagan Building, Washington, DC
January 21, 2010

Three members of the SAB Committee on Science Integration for Decision Making conducted two interviews with EPA's Office of the Science Advisor: Drs. Terry Daniel and Thomas Wallsten in person, and Dr. Thomas Theis by telephone. Dr. Vanessa Vu, Director of the SAB Staff Office, provided a brief introduction to the purpose of the interview and the Designated Federal Officer, Dr. Angela Nugent, took notes to develop a summary of the conversation. All interviewees were provided a copy of the committee's Preliminary Study Plan in advance.

Dr. Vu noted in each interview that the purpose of the interview was to help SAB Committee members learn about OSA's current and recent experience with science integration supporting EPA decision making so that the SAB can develop advice to support and/or strengthen Agency science integration efforts. Dr. Vu thanked participants for taking time for the interviews and Dr. Santhini Ramasamy for coordinating with the SAB Staff Office in planning the meeting.

Meeting with OSA Scientific Staff (1:00 p.m. - 2:00 p.m.) Participants:

Dr. Noha Gaber, Council on Regulatory Environmental Modeling Executive Director
Dr. Kathryn Gallagher, Risk Assessment Forum, Executive Director
Ms. Lisa Matthews, Chair of the EPA Group on Earth Observations (EPA GEO)
Dr. Santhini Ramasamy, Science Policy Council Staff
Dr. Neil Stiber, Science Policy Council Senior Staff
Mr. Michael Bender, Program Analyst Lead

OSA staff described their individual responsibilities for information sharing and other activities that integrate science across EPA. The Council for Regulatory Environmental Modeling (CREM) was formed in response to SAB recommendations regarding computational modeling. The CREM has focused on developing guidance to promote Agency-wide consistency and provide best practices in the development, evaluation and application of models. On January 21st, the day of the SAB meeting, the CREM was sponsoring a symposium on integrated modeling for large aquatic ecosystems, linking different aspects of environmental systems and anthropogenic systems by conducting multi-media and multi-disciplinary modeling to support policy analysis. The symposium developed from a 2008 CREM White Paper that focused on integrated modeling for integrated environmental decision making. The symposium provided an opportunity for modelers, program specialists, economists, and scientists to discuss how modeling tools could help integrate science for decision making. The CREM is preparing a response to a National Research Council report that focused on Models in Environmental Regulatory Decision Making. One of the recommendations from that report called for EPA to conduct retrospective analyses of how models perform and how they have informed decision making.

There are opportunities to enhance EPA's use of the CREM, especially in EPA regions. CREM staff are planning to build regional and program capacity for modeling through modeling seminars and workshops, web-based training for model developers and users, and formation of a national water quality modeling workgroup, which will use the new "Watershed Central" site that includes a Wiki.

If regions have questions about adapting an existing model to local issues or conditions, CREM staff relies on the Models Knowledge Base to help them identify model experts within or outside the Agency. The Models Knowledge Base must be continuously updated to provide reliable information. The Models Knowledge Base was designed to include case studies providing feedback on the use of models, but the model evaluation section of the database needs to be strengthened with applications for this feature to be useful.

Barriers to effective science integration in using the CREM and its tools include:

- Limited resources: only three people staff the CREM and the Models Knowledge Base.
- Data maintenance for the CREM Knowledge Base - CREM workgroup members often respond "we'd like to provide you with information but we don't have the time." Therefore, the process for including model information in the Models Knowledge Base should be better integrated with the model development and application work flow. Collecting quality assurance project plans needs to be integrated into the CREM Models Knowledge Base. The CREM is currently undertaking an analysis on this.

Leadership responsibility for EPA's Risk Assessment Forum (RAF) rests with the Office of the Science Advisor. The Forum is a standing committee of senior EPA scientists established to promote Agency-wide consensus on difficult and controversial risk assessment issues and to ensure that this consensus is incorporated into appropriate Agency risk assessment guidance. Work products of the RAF are approved by EPA's Science Policy Council.

The Forum is exploring ways to communicate RAF guidance more effectively throughout EPA. It does not currently have mechanisms for evaluating the use or effectiveness of guidance generated by the Forum. The RAF provides the public with opportunities to comment on draft guidelines before they are issued in final form.

The Science Policy Council (SPC) serves as a mechanism for addressing EPA's many significant science policy issues that go beyond regional and program boundaries. It develops policies and guidance for implementation across EPA. One example is EPA's Peer Review Handbook, last updated in 2006. The document has been well received, but OSA's SPC staff is aware that there is a need for better training on the peer review process across EPA and a mechanism for following up on the effectiveness of Peer Review Policy implementation.

The EPA Group on Earth Observations (EPA GEO) works on innovative ways to apply environmental observations, monitoring data and measurements with modeling and technology to support and inform decision-making by EPA and its partners in the States, Local Governments and Tribes. Global Earth Observation System of Systems (GEOSS)/Advanced Monitoring Initiative (AMI) projects will improve monitoring by visibly applying the benefits of science

observational data and information to the needs of EPA Program Offices and Regions and other user communities.

The GEOSS/AMI program has called for pre-proposals for FY 2010 projects, focused on efforts that further the development of GEOSS, support the Administrator's priorities and the SPC's Science Priorities, and articulate its application to improve environmental decision-making. EPA GEO has increased Program Office and Regional participation and is working to make this data and information more useful to environmental decision-makers. The OSA staff supporting GEOSS is currently supplemented by three AAAS fellows.

OSA carefully manages operations of its grants, contracts, and projects so that there are no duplications. All projects have quality management plans and are closely linked to OSA's missions and goals.

Meeting with the Chief Scientist and Managers (2:00 p.m. - 3:00 p.m.) Participants:

Dr. Pai-Yei Whung, Chief Scientist to the Science Advisor
Dr. Mary E. Greene, Deputy Director
Dr. Gary Foley, Senior Policy Advisor

The Office of the Science Advisor was established in 2002 by the EPA Administrator to ensure the highest quality science is integrated into the Agency's policy-making process. The Science Advisor advises the EPA Administrator on science and technology issues related to Agency policies, procedures, and decisions; participates in the ADP process; and chairs the Science Policy Council. OSA Staff support the Science Advisor in his/her mission to serve as an honest broker for cross-Agency science, science policy, and technology issues. Although OSA does not make risk management decisions, it facilitates conversations and communications about the integration of science to support decision making across EPA. For example, the Chief Scientist co-chairs the Science Policy Council's Subcommittee on Science Priorities. The Subcommittee provides a forum for assembling and organizing the science priorities of the Program Offices and Regions. These conversations led to the creation of a Science Priorities document (approved as "draft final" in 2009 by the SPC), which is currently being revised to reflect the evolving priorities at EPA. OSA "houses" important cross-agency councils and forums (the CREM, SPC, RAF, Forum on Environmental Measurement, and GEO).

The SPC provides a forum for science integration discussions among EPA's senior career managers. The SPC meets four-to-five times per year and has an efficient and effective process for preparing these senior leaders to have substantive policy discussions and reach decisions on key issues. The SPC Steering Committee supports the SPC and provides a mechanism for senior technical experts to address science integration issues.

The SPC provides a vision for bringing the EPA community together to make progress on science integration priorities. It is difficult to assess the overall impact of SPC policies and decisions; enforcement is "not the job" of the SPC. The RAF is considering the importance of workshops and training to enhance the usefulness of RAF guidelines. Both organizations receive feedback from EPA clients and must consider their documents "living documents" and develop

mechanisms for managing and improving them. The key to integrating science for decision making so there is "one EPA" is to enhance communication and opportunities to network across the Agency. Enhanced communication and networking are needed to address today's environmental protection questions and to anticipate the science needed for future decision making.