Scientific and Technical Advisory Committee
June 19-20, 2012 Quarterly Meeting Minutes
Doubletree Hotel - Annapolis, MD

June 19 Minutes

Attendance:

Members: Charlie Abdalla, Brian Benham, Donna Bilkovic, Charles Bott, Russ Brinsfield (T), Randy Chambers (T), Michael Ford, Carl Friedrichs, Marjy Friedrichs, James Glancey, Kurt Gottschalk, Carl Hershner, Robert Hirsch, Susan Julius, Hamid Karimi, Poornima Madhavan, Jack Meisinger, Ray Najjar, Michael Paolisso, Jim Pease, Chris Pyke, David Sample, Lisa Wainger, Denice Wardrop (T), Don Weller, Claire Welty, Gene Yagow

Guests: Jessica Blackburn, Karl Blankenship (T), Nick DiPasquale, Eddie Durrant (T), Melanie Frich, Rick Keister, Doug Lipton, Joseph Maroon, Jamie Mitchell, A. Pappano (T), Scott Phillips, Lucinda Powers, Amanda Pruzinsky, Gary Shenk, Daniel Strain, Peter Tango, Richard Tian, George Van Houtven, Ping Wang

Administration: Melissa Fagan, Natalie Gardner, Matthew Johnston, Kevin Sellner

Announcements and Consent Agenda - Chris Pyke (USGBC)

STAC Chair, Chris Pyke, called the meeting to order shortly after 10:00 am. Following member introductions, Pyke announced the upcoming July 9, 2012 CBP Executive Council (EC) meeting. STAC's Executive Board (EB) developed three messages that STAC plans to present to the EC. Pyke requested that members review the messages during lunch, and discuss the three themes.

Pyke requested a motion to approve the consent agenda. Before membership approval, Pyke briefly discussed a Memo Of Understanding (MOU) in development between the Chesapeake Bay Program (CBP), and STAC. Additionally, Gary Shenk (EPA-CBPO) announce that the Modeling Laboratory Action Team's first meeting will be June 21, 2012.

VOTE: Pyke asked members for a motion to approve the consent agenda. Results: Motion carried - consent agenda approved.

Natalie Gardner, STAC Staff, reminded members to complete the survey titled " STAC Member Volunteer Hours from March 1, 2012 to May 31, 2012" before COB on Wednesday, June 20, 2012. The survey results are reported to the Chesapeake Bay Program Office (CBPO), and used in the STAC EPA quarterly reports.

Action: Gardner will resend volunteer survey to STAC members.

Results of Data Analysis on Nitrogen, Phosphorus and Sediment Fluxes From The Susquehanna River to the Bay in Tropical Storm Lee, 2011 - Bob Hirsch (USGS)

In September 2011, Tropical Storm Lee made its way up the Chesapeake Bay. The water quality data collected by the USGS during Tropical Storm Lee provide important new insights into the changing pattern to delivery of nitrogen, and especially phosphorus and sediment from the

Susquehanna River into the Bay. Bay Program partners are interested in what happens when large flows occur near the Conowingo Dam during high flow events, such as Tropical Storm Lee. Two days after the peak of the storm, satellite images observed visible sediment in the mouth of the Potomac River. At discharges of 400,000 cubic feet per second is when the initiation of scour becomes presents, which causes sediment from storage to move into different portions of the Bay. During Tropical Storm Lee, discharges of over 700,000 cubic feet occurred. The Conowingo reservoir is in the process of filling up, and scientists expect the reservoir to fill completely in the next few years. Results from this study showed that Total Nitrogen (TN) concentrations are continuing to decline at most discharges, but at very high flows, it shows some increases. For Total Phosphorus (TP), concentrations are relatively stable at moderate and low flows, but at very high flows, it has increased greatly in the past 15 years. Furthermore, Suspended Sediment (SS) flow-normalized flux is rising very quick, and variability is increasing. According to Hirsch, there is a scientific need to improve temporal resolution of monitoring during high flow events, and continued data collection upstream and downstream of reservoirs. Over the coming decades, the state of the reservoir may be the main driver of TP and SS inputs to the Bay.

Tropical Storm Lee Effects Workshop Plan and Initial Findings - Peter Tango (USGS-CBPO)

The CBP's Science, Technical Analysis, and Reporting (STAR) team hosted a workshop in April 2012 that reviewed the 2011 Storm Effects on the Watershed, and the Chesapeake Bay. Following the 2011 collection of sampling, STAR and other Bay program partners hosted the workshop to analyze the data collected shortly following the storms. Tango summarized presentations that were made at the April workshop, and reflected on the overall outcome of the storm events. According to Tango, 2011 had the second highest flows on record since Hurricane Agnes in 1929. Evidence showed high concentrations of sediment in the upper bay. Additionally, March-May of that year had the highest 3 month flow conditions ever recorded in the Susquehanna River. Overall, the combination of the spring, and fall events contributed to the conditions of the Bay in 2011. Calculations were developed to estimate the amount of sediment deposited following the storm events. Some of the data seem to corroborate the idea of a thin layer sediment distribution in the upper Bay, but more data is still being evaluated. There was a tremendous amount of nitrate/nitrite measured in early October, and was well above average. Additionally, destratification and restratification observed in the lower Rappahannock River was one of the worst conditions since the 1985 record began. Impacts from the storms were able to be tracked through time series data, which presents new opportunities to analyze high density, and high frequency data profiles. Furthermore, living resources, particularly SAV beds, dropped significantly in the upper Bay. Additionally, the lower Bay had increases in widgeon grasses, which may, or may not persist into 2012. In Virginia, most SAV decreases in the region were due to eelgrass loss from heat stress in the summer of 2010. Oysters experienced high mortality in the upper Bay, but had excellent bay-wide survival. Currently, there are plans to develop a meeting to synthesis Bay wide responses to 2011 conditions. The meeting is tentatively scheduled for the first week in December, 2012. This meeting will include keynote speakers, presentations, poster sessions, and discussion of management implications and concerns.

Chesapeake Bay Program GIT Decision Framework Update - Carl Hershner (VIMS)
Currently, CBP is implementing adaptive management into the program through the decision framework method. Hershner was asked by CBP's Management Board (MB) to examine, and assess the current Goal Implementation Team (GIT) goals. After examining the 6 GITs, Hershner was able to identify 27 goals. Overall, activities within each workgroup/GIT do not address CBP's overall goal. Instead, each GIT tends to tackle one aspect of that entire goal. Hershner recommends the GIT focus on accomplishing objectives, pertinent to their portion of the watershed. Additionally, Hershner summarized the March 2012 STAC quarterly meeting/retreat, which primary focus was to examine current GIT goals, and developed recommendations to CBP on how to implement adaptive management. Hershner feels STAC can continue to play a strong role in the adaptive management process. Currently, GIT chairs will present their current GIT goals to the MB in August, and receive feedback on their status. STAC has the opportunity to suggest programmatic changes in moving the adaptive management process forward. Hershner would like to determine what STAC's role will be in the future of implementing this process.

Discussion: Pyke suggested STAC add expertise to its membership to address this issue, or have the current membership huddle together to assist the Program. Hershner would like STAC to provide guidance to the partnership, and encourage the program to focus on issues other than water quality. The decision framework will not solve all political issues, but it will help move the program into the desired environmental outcomes. Lisa Wainger (UMCES) would like to know exactly what STAC is being invited to do? Hershner clarified that STAC has the opportunity to proactively suggest, and evaluate the goals, and determine whether the goals are reasonable, and attainable for the Program. Hamid Karimi (DDOE) felt STAC has the expertise to examine the decision framework. Ford did not see how the current goal structure showed ways each GIT will make progress with internal communication between each GIT, and the overlapping goals. Members had a back and forth discussion comparing different regional, and national Ecosystem Based Management with CBP. Sellner suggested an outside expert come in to evaluate STAC membership, and determine where the committee is lacking expertise.

Action: Wardrop volunteered to join an ad-hoc workgroup to assist Hershner in implementing adaptive management within the CBP.

STAC's Executive Council Message - Lunchtime Discussion
The 2012 Executive Council (EC) meeting is scheduled for July 9, 2012. The lunchtime discussion was a chance for the members to have an open, and candid discussion regarding the EC report, and determine whether the message is clear, and coincides with current STAC activities. Better Models, Better Policy, and Better Outcomes are the three overarching messages in the STAC report. Members discussed these messages over lunch, and agreed to present them to the EC.

Potential Economic Impacts of Trading on the Cost of Implementing the TMDL - George Van Houtven (RTI International)
RTI International released a report that estimated the potential costs savings from hypothetical trading scenarios applied to the Chesapeake Bay Total Maximum Daily Load (TMDL). The report was sponsored by the Chesapeake Bay Commission, and the Linden Trust for

Conservation. The objective of the study was to investigate the potential costs savings from including nutrient trading into strategies to meet the Bay TMDL, and to estimate how the potential costs savings are affected by different trading scenarios. The scenarios included different limits on participation by pollution sources, wastewater facilities, agricultural, urban sources, and on the geographic extent of trading. A trading program gives participants the incentive to find trades that receive load reductions at a lower cost. RTI went through a 9 step process to identify a solution with the least cost, and compare it to costs that would occur without trading. Instead of looking at the individual programs and modeling what they are doing, the study used a uniform set of rules for the entire basin. This analysis compared two main scenarios, trading and no trading. Rather than looking at individual gains in trading, the report focused on total cost savings. Additionally, the analysis included obstacles, but the results should be interpreted as "best case scenarios" or "upper bound" estimates of cost savings. Key inputs for developing the framework include: watershed network and segmentation, land use/cover, delivered loads, BMP nutrient removal rates, and acres of BMP implementation. Additionally, the study looked at three short-term scenarios, and one long-term scenario. The scenarios found that nutrient credit trading has the potential to substantially reduce the costs of achieving TMDL limits for the Bay. The potential cost savings are greatest when trading is allowed across the entire watershed, and particularly high when regulated urban sources are allowed to purchase credits.

A Regional Work In Progress: Trading Within the Chesapeake Bay Watershed - Joseph Maroon (Maroon Consulting, LLC)

Over the past year, Maroon has been actively engaged in reviewing the status of nutrient trading, the policies, and programs in the region. Maroon's work focuses on trading programs within the three main bay states (MD, PA, VA), EPA, and regional efforts. While there is a wide range of opinions concerning trading, most people agree there are a number of emerging issues in existing programs that must be addressed for trading to be successful, and protective of water quality in the Bay. Maroon was able to identify several issues that must be considered during the development of nutrient trading programs. Trading offers the possibility for reducing the cost of meeting the TMDL, assistance in permit compliance, accommodating future growth, potential innovation, and private investment. Trading is not only about cost, it is also about policy. According to Maroon, the partnership could make decision that could accelerate trading, but might jeopardize water quality. Overall, it is critical that water quality protection remains the primary, and overarching focus as we move ahead. Virginia and Maryland recently updated their trading programs this past legislative session. Maroon is concerned with how each state generates credits because credits varies state to state. In Virginia, there are three ways to generate a trade; (1) Waste Water Treatments Plants can exceed waste load reductions; (2) farms can exceed five priority practices or; (3) landowners can convert to less intensive use (i.e. convert cropland to forest). Issues in nutrient trading include inconsistent baselines, trades involving nonpoint sources, and interstate trading. Nonpoint source credits have much less assured outcomes from point source technology upgrades, and this issue needs to be adequately addressed before moving forward with trading. According to Maroon, a trading ratio greater than 1:1 is a great way to address the uncertainty of outcome, and use that ratio as the default when a nonpoint source is involved in trading, unless the project can show a high degree of success. Furthermore, nutrient trading has the possibility of degrading local water quality. One possible option to ensure the protection of local waters is to develop a standard protocol for

permit writers. Finally, Maroon believes the opportunities of nutrient trading our promising, however, the Bay region needs to be willing to take a hard look at the alternatives, and needs to address the challenges moving forward.

Action: STAC staff to distribute Maroon's report regarding state nutrient trading programs.

Update on the EPA and CBP Trading and Offset Workgroup Work Plans - Nick DiPasquale (EPA-CBPO)

DiPasquale provided a short summary of EPA and Chesapeake Bay Program's Trading and Offset Workgroup Work Plans, and the next steps moving forward. According to DiPasquale, nutrient credit trading and offset programs in the Chesapeake Bay watershed must be credible, effective, and economic tools to meet water quality goals. DiPasquale mentioned several challenges to implementing a Bay wide nutrient trading program for nonpoint source trades, especially in the agricultural sector. EPA's expectation for a trading and offset programs were set up based on Section 10, and Appendix S of the Chesapeake Bay TMDL. EPA conducted an assessment of Bay jurisdiction trading and offset programs to determine whether they were consistent with the Clean Water Act, and the TMDL. Final assessments were transmitted to jurisdictions in February 2012. However, EPA does not have legal authority to dictate how the jurisdictions' programs should look. Additionally, EPA identified both jurisdiction-specific, and concerns common to all jurisdiction, that must be address by the end of 2013. Based upon the assessments and stakeholder feedback, EPA drafted a workplan, which includes four major components: (1) addressing assessment findings; (2) oversight program; (3) program development and guidance and; (4) outreach, education, and integration program. For example, one workplan priority project is to develop a Technical Memoranda (TM) on baseline, and sector demonstrations. An oversight program will determine the success of the Trading and Offset Program, specifically making sure the program conforms to NPDES regulations, and the TMDL. The third section of the workplan, program development and guidance, is the stage where EPA plans to create a series of TM to assist jurisdictions in implementing their action plans, and strengthening their trading programs. Finally, an outreach program is important to ensure that an ongoing forum exists to clearly establish expectations, and to address concerns raised by federal agencies, jurisdictions, and other partners. The majority of the TM will be issued in 2013. EPA is concerned that the private sector will not participate in trading under the TMDL, unless and until the rules are made clear, and responsibilities are appropriately assigned.

Nutrient Trading Panel Discussion

Van Houtven, Maroon, and DiPasquale answered several questions that STAC members had regarding nutrient trading. In particular, Hershner asked DiPasquale who within the Bay Program will develop the TM. DiPasquale said the CBPO plans to draft the TM, but they will primarily come from EPA Region 3, with assistance from EPA Headquarters. Additionally, Hershner pointed out how these activities are a perfect example of implementing adaptive management into CBP. Sellner asked DiPasquale which jurisdictions relied heavily on nutrient trading in the Phase II WIPs, and were the jurisdictions asked to adjust their plans to include nutrient trading if not. DiPasquale responded that VA, and PA relied heavily on trading in the Phase II WIPs, but plans will be evolving over the next several months. DiPasquale invited STAC's economist to be involved by reviewing nutrient trading plans/development of technical memoranda created by CBP over the next several months.

Update from CBP's Social Science Action Team - Lucinda Power (EPA-CBPO)
On May 9, 2012, the CBP MB approved the creation of a Social Science Action Team (SSAT) to identify, evaluate, and develop opportunities for applying social science methods, and research finding into the Chesapeake Bay Program Partnership. One recommendation stemming from the STAC Social Science Workshop Report was for CBP MB to create a SSAT to explore opportunities for better integrating social science research, and findings into CBP priorities. Power would like STAC members to nominate experts to serve on the action team. One focus of this action team will be to increase awareness of the social science disciplines, and demonstrate value of social science to the Bay Program Partnership. Power pointed out that social science research is already happening in the Bay watershed, but the action team will bridge the gap between natural and social sciences, and help integrate social science methods and research into the Bay Program's priorities, and decision making framework. Power is proposing the action team be comprised of 8-10 social scientists representing both the Bay jurisdictions, and the CBPO. The action team believes a one year term is appropriate for taking on the proposed actions. The research needs across the watershed include behavior-change research, economic research, research on the cultural landscape, and research to address communication barriers. The action team will focus on identifying opportunities within CBP that show how social science research can help achieve goals, demonstrate how social science has made a difference in the environmental field, and integrate social science research and findings in CBP. Power identified several short-term, and long-term action items developed by the team.

Action: STAC members will send Lucinda Powers nominations for the Social Science Action Team by June 29, 2012. STAC members should also indicate if they are interested in participating on the action team.

Understanding the Psychology of Bay Restoration Efforts - Poornima Madhavan (ODU)
Madhavan specializes in studying human decision making, and understanding decision making related to sea level rise, and understanding the gap between knowing, and acting. Madhavan surveyed the residents of Norfolk, Virginia to try and determine if residents understand, and believe that climate change, and sea level rise is threatening their area. Norfolk is one of the most vulnerable cities to sea level rise in the United States, second only to New Orleans. The case study looked to explain the public's (lack of) reaction, how residents understand, and process information to make decisions. Madhavan constructed, and tested a social science driven process model (ABC model of Behavior) on communicating these issues, in hopes to excite public engagement in climate change, and sea level rise support for policy. The current project, funded by Old Dominion University (ODU), was conducted in several stages, focused on understanding how people identify with the area they live in. The first stage involved a telephone survey of a sample of Norfolk. From that sample, ODU walked away with 614 completed interviews (60 questions, 15-20 min surveys). The ABC Model of Behavior was used to understand, and interpret the result from the telephone surveys. Madhavan presented the results from the data gathered. To understand behavior in Activating Events (A), the data responses were classified into one of the four flood zones (storm surge zones), one being most likely to flood. The results found that most residents emotions fall into one or two categories, "there is only so much you can do," or "let's deal with it later." The Beliefs (B) portion of the model tried to understand if residents believe they have anything to do with sea level rise, and flooding in the city. Based on the results, Madhavan concluded that 63% of people do not feel

guilty when thinking about sea level rise. Finally, the third portion of the behavior model, Consequence (C), tried to target the cities awareness, perceived urgency, and willingness to support action. For example, the city of Norfolk spent a substantial amount of money to lift one block by a foot and a half. Residents were asked if they were aware of this type of government action. The survey results showed that 62% of residents did not believe the local government spent money to lift one block in a vulnerable area. The next step in this study is to actively reach out to the community through seminars, listening sessions, recreational education techniques, and mock adaptation exercises. The hope is to target different audience segments through varying techniques according to specific needs. Researchers are currently trying to work with the private sector, public sector, and the community, to determine their level of concern, and how the city plans to react.

Discussion: Sellner suggested the CBP's Director of Science (Rich Batuik) attend all Social Science Action Team meetings, to help push the CBP managers to better incorporate social science into restoration.

Action: STAC staff will work with the SSAT to discuss developing a social science page on the STAC website which could house social science articles relevant to Chesapeake Bay restoration.

June 20

Attendance:

Members: Charlie Abdalla, Brian Benham, Donna Bilkovic, Randy Chambers (T), Michael Ford, Carl Friedrichs, Marjy Friedrichs, James Glancey, Kurt Gottschalk, Carl Hershner, Robert Hirsch, Hamid Karimi, Jack Meisinger, Ray Najjar, Michael Paolisso, Jim Pease, Chris Pyke, David Sample, Lisa Wainger, Denice Wardrop (T), Don Weller, Claire Welty, Gene Yagow

Guests: Jessica Blackburn, Karl Blankenship (T), Raleigh Hood, Will Hunley, Rick Keister, Lewis Linker, Eileen McLellan, Pasky Pasquale, Amanda Pruzinsky, Gary Shenk, Jeff Sweeney, Richard Tian, Ping Wang

Administration: Melissa Fagan, Natalie Gardner, Matthew Johnston, Kevin Sellner

Consent Agenda Approval Continued - Chris Pyke (USGBC)

Pyke requested a motion to approve the March, 2012 quarterly meeting minutes.

VOTE: Pyke asked members for a motion to approve the March, 2012 quarterly meeting minutes. Results: Motion-carried - March, 2012 quarterly meeting minutes approved.

Nutrient Trading Discussion Continued - Charlie Abdalla (PSU) and Others

Based on yesterday's conversation, Abdalla is concerned that CBP managers are not receptive to previous nutrient trading work done by STAC. Additionally, CBP managers do not understand STAC's role within CBP, and members want to clarify STAC's role within the Partnership. Pease suggested that STAC evaluate state nutrient trading programs. Furthermore, Wainger recommended that STAC be more persistent, and more relevant when it comes CBP decision makers. Hershner suggested that STAC economist, and water quality experts meet with CBP

management to discuss opportunities for STAC to assist CBP in reviewing, and developing nutrient trading plans/TM.

Action: Abdalla, Pease, and Wainger will meet with DiPasquale and CBP management team to discuss STAC's previous nutrient trading work and identify immediate opportunities for STAC to assist the CBP in reviewing nutrient plans/developing technical memoranda for plans.

M3.1 Workshop Update: Using Multiple Models for Management in the Chesapeake Bay - A Shallow Water Pilot Project - Marjy Friedrichs (VIMS)

STAC conducted a workshop on April 26-27, 2012 at the Virginia Institute of Marine Science (VIMS) to discuss implementing multiple models in the Watershed. STAC has been discussing the use of multiple models for several years. The National Academy of Science (NAS) review, STAC LimnoTech Review, and the CB Hydrodynamic Modeling Workshop Report caused STAC to write a series of letters to CBP MB recommending how to use hydrodynamic/water quality models in the watershed. At the STAC 2011 December quarterly meeting, STAC recommended CBP models continue to be used as the sole regulatory model for water quality management decisions with several other community models being used for comparison and R & D. This would demonstrate that the CBP model is equally as skillful as a range of models routinely use by the scientific community. From a series of back and forth letters between STAC and CBP MB, STAC agreed to host this workshop to assist in implementing a multiple model shallow water pilot project. The goals of the workshop was: (1) define elements that should be included in such a pilot project and (2) discuss benefits and challenges of using multiple models in a regulatory framework. The workshop was accepted, and divided into two separate STAC workshops, based on the goals listed above. The consensus among workshop attendees was that the shallow water pilot project should to improve shallow water simulations of light and dissolved oxygen (while indirectly improving SAV). Additional outcomes include: identification of new model for the shallow waters and/or suggested improvements to existing model; develop confidence estimates for existing CBP shallow water simulations and; demonstration of feasibility of using multiple CB models. The workshop suggested the pilot project serve as a demonstration project, to display the feasibility and utility of using multiple models. Methods for completing this project include: 3-6 modeling teams (including current CBP simulation), and 1 model comparison team (not one of the simulation teams); at least two contrasting sites with preferably 3-5 years in order to capture some inter annual variability. Site selection was not determined at the workshop, however, attributes and characteristics of sites were developed. According to workshop participants, modeling teams must use forcing fields provided, and CBP model open boundary conditions. CBP must provide necessary forcing for all teams (including CBP model output through 2011). Estimated funding is $100-$200K per team/per year.

M3.2 Workshop Update: Using Multiple Models for Management in the Chesapeake Bay - Implications for Regulatory Decisions - Don Weller (SERC)

Weller described the complimentary STAC multiple modeling workshop set to take place in fall, 2012 as a follow up to the M3.1 workshop. Objectives of the workshop include: catalog the various meaning of the term "multiple models;" identify which meaning have been used by STAC, the CBP, and other CB stakeholders; catalog the advantages (and disadvantages) of multiple models; present case studies of past successes (and failures) of multiple models in

decision making and regulations; consider how multiple models can (or cannot) work given Clean Water Act (CWA) requirements and standard for setting, and enforcing TMDLs; and describe how CBP models are currently used in management decisions, and how this might change with multiple models. The steering committee is interested in case studies of application of multiple models. Additionally, the steering committee is looking for additional members familiar with watershed modeling, or legal experts on CWA and TMDLs.

Chesapeake Community Modeling Program (CCMP) Activities - Raleigh Hood (UMCES)
The CCMP was created based on recommendations from a 1999 STAC report titled "Review of the Water Quality Model." The report was highly critical of the estuarine model both in terms of how it was developed, and how it performs. It was recommended that the model not be used for management purposes until certain problems were addressed. Chesapeake Research Consortium (CRC) then convened a small group of member-institution scientists to discussed the need for a new Chesapeake Bay modeling initiative. As a result, the group created a short, formal report which stated in part: "A vigorous initiative is needed to provide the scientific foundation for the next generation of coupled estuarine circulation/ecology models, which in turn is needed to support water quality managers and decision makers in the public policy sphere, and a wide spectrum of research and educational activities." In 2002, CCMP conducted a workshop to promote the development and free dissemination of open-source models for Chesapeake Bay scientific management application, and review state-of-the-art open-source airshed, watershed, and estuarine models. Today, CCMP publishes quarterly newsletters which provide various updates about CCMP activities, and a piece featuring modelers. CCMP is now a synergistic effort with CBP modeling subcommittee, to promote a greater transparency through the use of open-source community modeling approaches, and help CBP achieve its goals in reducing nutrient pollution in the Chesapeake Bay.

Policy Implications of Using Multiple Models - Eileen McLellan (EDF)
From the policy perspective, multiple models increase the difficulty of science communications, increase the perception of uncertainty, and provide a convenient framework for stakeholder demand to postpone action until uncertainty is resolved. EPA, and CBP is facing decreased funding for restoration, decreasing timeline for restoration goals, and is challenged with determining how to best invest those resources, time, and money in order to meet Bay goals. Challenges that CBP faces are economic obstacles, issues in social behavior, and problems understanding scientific processes within the Bay. McLellan questioned "what is the role of modeling in decision making, and what is the role of science in decision making." McLellan pointed out that science, and models do play a role in decision making, however, policy makers need to consider an array of other inputs. As an example, a recent poll suggested that 97% of scientists believe in climate change, and that climate change, in part, is due to man-made causes. When the issue of climate change was being debated on Capitol Hill, only 52% of the public was believed that climate change was real, and man-made. Based on that evidence, decision makers opted to do nothing related to climate change due to the public's perception of this issue. McLellan believes the role of modeling in decision making is to inform decision, not to make decisions. However, this is not understood by decision makers themselves, and the general public. McLellan agrees that improvements should continue to be made to models, but is unsure whether multiple models are necessary. According to McLellan, it seems to be a communications problem, and not a science problem. McLellan advised STAC to consider a

discussion at the upcoming STAC modeling workshop on how the public perceives models, how the public understand models with conflicting answers, and how can that be messaged in a way that does not lead to inaction.

Weight of Evidence and Environmental Models - Pasky Pascual (EPA)
When can it be said that the weight of scientific evidence supports a regulatory decision. Federal law requires that all regulatory decisions be based on rationality, even as most environmental laws demand that these decisions be based on science. When using multiple models to rationally establish weight of evidence, regulators must demonstrate the following: (1) the modeling methods were appropriate to the system being modeled and (2) the methods lead transparently and coherently to the inferences being proposed. Pascual argues that for any major regulation, you will find a model. According to Pasquale, evidence needs to cross a threshold (and courts), and give authority to implement regulatory decision, and allocate legal rights, and obligations. Pasquale, and colleagues are writing a paper focused on how information is converted into an inference, and what the inference means in a way that lawyers and judges can understand. One problem with regulations is they tend to be prospective. Additionally, models are used for regulations that occur in the future, and regulations are not actually used to develop the model. Furthermore, assumptions are being made that are not observable, and we now understand that multiple models can be developed based on the prospective data. Pasquale believes a problem is that one must estimate an observable set of model parameters, based on un-observable data. According to Pasquale, multiple models should: (1) be transparent and coherent; (2) allow plaintiff to rebut by establishing and; (3) justify more evidence with value of information.

CBP Perspective on Multiple Models - Gary Shenk (EPA-CBPO)
Shenk provided a short description of EPA-CBPO's perspective on multiple models. According to Shenk, CBP sees multiple models as a benefit because it causes greater involvement of the scientific community, great confidence in model outputs, and increases pace of scientific advancement. However, challenges to multiple models include: time and money for development; complication in understanding how multiple models will work in a regulatory framework; and understanding the operational challenge being faced. The Bay Program's current strategy to move forward at a slow, and steady pace by actively participating in the STAC M3 workshops, the Modeling Laboratory Action Team (MLAT), and consideration of M3 in future development plans. Shenk went on to describe an idea about multiple models that is different from the traditional view of multiple models, and tried to describe the fundamental difference between the estuarine model, and the watershed model. Shenk ended the presentation with several science questions, and management questions, that need to be discussed while developing and understanding multiple models in a regulatory environment.

Multiple Modeling Panel Discussion
STAC members asked Hood, Weller, Pasquale, Friedrichs, and Shenk several questions related to their presentations on multiple models. Back and forth discussion occurred between the panel, and STAC members on how to effectively implement multiple models, and how to deal with the existence of multiple models.