

**APNEP Scientific and Technical Advisory Committee
Spring Meeting
April 30, 2008
Jockey's Ridge State Park, Nags Head, North Carolina**

STAC Members Present: Wilson Laney, Kirk Havens, Tim Spruill, Jeff Hanson, Nancy White, Don Field, Jud Kenworthy, Pete Kalla, Lorry King, Marty Lebo, Robert Reed, Enrique Reyes, Stan Riggs

Staff Present: Dean Carpenter, Bill Crowell

Liaisons: Beth Burns (NC-DMF), Gordon Cashin (NC-DOT), Chad Boyce (VA-DGIF), Jack McCambridge (VA-DOT)

Presenters: Bob Christian (ECU)

10:10 AM: **Call to Order: Nancy White:** Nancy convened the meeting. She noted she lived the closest and was the next to last to arrive. She asked if anyone had any changes or corrections to the minutes from the STAC winter meeting. Approval was moved and seconded.

10:11 AM: **APNEP Update: Dean Carpenter:** Dean gave an update for the STAC. He noted this is the last meeting of the 2007-2008 session. Mike Rikard couldn't be here, because he is meeting with the military regarding overflights at Cape Lookout National Seashore. Mike had told Dean he would rather be here. Dean addressed attendance, and noted that we had recognized those in the 2004-2006 session who had made all meetings except one. He noted the staff wanted to recognize members Field, Havens, Laney, Spruill, Reed and Rikard for their excellent attendance in the 2006-2008 session. They will be getting certificates of appreciation. Dean noted that Kirk and Michael are repeating their performance of the last session. Dean noted the restrooms were out the door to the left. Dean thanked all the agency liaisons who were present. Dean noted that Ross Lunetta, Doug Rader and Bob Christian had all resigned from the STAC since the last meeting. Dean noted that we have two proposed new members, Craig Landry and Joe Fridgen, and members should vote by Monday. Dean noted the STAC Executive Board had met on February 23rd. Any members interested in the minutes can get copies. Our next meeting will be in Greenville, July 30th. Five STAC issue papers were presented to the Policy Advisory Committee yesterday. Dean thanked the lead authors, as well as reviewers, for their work on the issue papers. Tim Spruill authored three of the papers. Enrique Reyes was lead author on the database paper. Dave Mallinson and Heather McGuire authored the climate change paper. Dean noted that we would have some discussion later around lunch, about where we want to go with these papers, and others as well. The Citizens Advisory Board will be meeting May 21 at the Cashie River Center in Windsor. Dean noted that traditionally, we have had the fall meeting be a joint meeting with the other boards. He will let us know what transpires. Bill Crowell asked if anyone was planning on attending the Restore America's Estuaries Conference. That conflicts with the date they had tentatively selected in October.

Nancy thanked the next two speakers for coming and noted that we have been tracking this issue since the beginning. She noted the University has been working with the Army Corps of Engineers (ACE), and the National Oceanographic and Aeronautics Administration (NOAA), to do better disaster preparedness, and obtain better data. She noted that we would hear from Bob Christian, regarding NC-EONS, and then Jeff Hanson will discuss MORPHOS. Nancy noted the partners for the EONS program. They included North Carolina State University (NCSU), UNC-Wilmington, UNC-Chapel Hill, East Carolina University (ECU), Renaissance Computing Institute (RENCI), Coastal Studies Institute (CSI), Duke University Marine Lab (DUML), and ACE (Jeff Hanson from the ACE Field Research Facility in Duck).

10:20 AM: Environmental Observation Network System for North Carolina (NC-EONS): Bob Christian:

Bob noted that it was really Rick Luettich ([UNC-IMS](#)) who came up with the idea and applied for the funding. Bob noted there is a big group of people who have been involved in putting the proposal together and getting support for it, and making sure that it has some long term life. The funding came to UNC-Wilmington, on January 8, and they had the first organizational meeting on January 9. The funds have to be spent by June. The track has been a fast one, to get the platform put up and the sensors on. The group met and organized in subcommittees, and made sure the platform design was right, and developing the outreach component. Bob noted that Don Stanfield is involved and doesn't usually get enough credit for his work. He has really been the person who helped design the platform and works on the day-to-day logistics. He is at [NCSU-CMAST](#) and works with CMAST Director, Dave Eggleston. Also they went to Cedar Island and met with NC-DOT, who has been very instrumental in developing the communications network, and shuttling things out to the platform. The platform is located in southern Pamlico Sound, near the ferry route and near areas that Hans Paerl (UNC-IMS) has been monitoring. The platform is 18 x 18 feet, about 15 feet above the water. It is being designed to withstand 115 mph winds. Sixteen pilings were installed by April 25. Bob showed us the platform design, side and aerial views. Much of the space will be taken up by solar panels, sensors and sensor connections. There will be a protected instrument house. The Renaissance Computing Institute ([RENCI](#)) is a partner in the project. It will use a combination of solar and wind energy to maintain the equipment. There are three levels of communication. Bob shared the technical details of those communication systems. Instrumentation will include live video, meteorological and water level measurements, waves, currents and hydrography. Many of the sensors are donated. It really is a collaborative project. Water quality parameters measured will include temperature, pH, dissolved oxygen (DO), salinity, chlorophyll, near-bottom DO levels, gas chromatograph, and hydroacoustic gear to listen to fish. Data will be available directly to participating scientists and to the public via the NC-EONS site. [SEACOOS](#) will be involved for data storage. There are shared aspects about the communication and storage of the data. There will be several portals or avenues for accessing the data. Bob showed us some pretty pictures associated with the project. The Cedar Island Ferry Terminal is their point of egress. The site had to be dived upon to do the pre-permit survey. There were no seagrass or oysters on the site. Pilings were carried to the site via barge and installed with a crane. All the pilings are now installed by the contractor. Bob

showed us the [NC-EONS web site](#), which he noted isn't yet populated with a lot of information. Hopefully in the coming months we will see a lot more.

Nancy asked about security. Bob asked what sort of security she thought the platform needs. Nancy noted that there is a ladder for access. Bob noted that there are ways to lock the access. Wilson noted that on the tide traps FWS used, they put the monitoring equipment inside heavy-duty steel cases, inside wooden cases, to try and avoid impacts from target-shooting. He noted that there was at least one shotgun pattern on the box before the study ended. He asked when the next platform would be installed. Bob noted that Jeff Hanson was going to talk about that aspect.

Jud asked why isn't NOAA a partner in the project. Bob wasn't sure. He noted there are a lot of partners. He noted that he had communicated with some of the folks in NOAA. Nancy noted the RFP gave them about three days to put the proposal together. She addressed the funding, which she noted it in the budget again this year. Essentially, whoever answered their e-mail was who got involved. Jud suggested that he could be a contact person for the NOAA lab. Jud noted that several of the scientists at the lab have been working on similar regional monitoring proposals. Bob noted there is no reason for NOAA not to have been involved. Jeff noted that there is definitely NOAA funding involved in the data aspect. Jud noted that is at another level, but he would like to see some local Beaufort involvement.

It was clarified that the entire operation will be operational by June, which is remarkably fast for a group of academics. Someone asked how the operational expenses will be provided. Bob indicated that CMAST has committed Don Stanfield's time and is providing a lot of that support for the foreseeable future. Each individual sensor is the responsibility of the collaborators. If a sensor goes down, whoever contributed it is responsible for replacing or repairing it. Bob noted it is unfortunate that is the way most of the similar projects are working right now. The question was asked about the track record of projects like this one. Do all of a sudden the data stop, due to lack of maintenance? Bob stated there is the monitoring world, and the observing world. A few years ago there was a paper in Nature which reviewed the marine monitoring programs. About half of them dropped out after three years. The hope is that if this is part of a national network, the likelihood is that it will be maintained. The estimate for a national system is \$300-500 million, but NOAA's total competitive grants budget this year was only \$21 million, so there is a long way to go. Bob noted that a lot of the local or regional alliances are working pretty well. Bob and Tim noted that it isn't sexy work, but it yields a lot of useful data. Tim stated that it would be worthwhile to go the legislature, and the university system, to try to get commitments for at least ten years of funding. Whenever the money disappears, the program just stops.

Bob noted that such strong initial cooperation between the universities is rare. He indicated that once it gets embedded in the budget, it is more likely to remain. There is hope for it.

10:45 AM: MORPHOS Advanced Coastal Process Research Modeling: Jeff Hanson:

Jeff noted that Bob had given him a great introduction. Jeff noted he was going to show us that

NC-EONS is just a piece of a much larger picture. There are a lot of other federal partners, including the ACE, NOAA, and Federal Emergency Management Agency (FEMA). Jeff noted his talk would be somewhat broader than just MORPHOS. Jeff gave us an overview of the facility, which is located at Duck and has been in place since the mid-1970's. It was originally focused on coastal erosion, sand movement, but in the last few years they have come out of their shell. They are broadly partnered and networked with a lot of other partners, and are doing more in the way of numerical modeling and model validation.

Jeff noted that our coasts are at risk. The 2004 hurricane season was an eye-opener, followed by Rita and the second storm at New Orleans, in 2005. Issues include development pressure, increased storm activity, wetlands, sea level rise, and subsidence. The ACE modeling weaknesses were exposed by these major catastrophes which transcend past experiences. The events exceeded the range of model tuning.

Bob noted that Hurricane Isabel also challenged the area. The challenge is to predict how the winds, waves and currents will affect the sediments and habitats.

There are lots of observations that have been done since the mid-1970's. New things going in this year include a cross-shelf wave array. They go from 5 to 11 m depth, but ones are being added that reach to 48 m depth offshore. This is a robust, long-term system. They are also going along the coast, with an along-shore wave and current array. They are placing equipment off other piers, at Jeanette's Pier, and Kitty Hawk. They are trying to build a better prediction tool for rip currents. They also have an Albemarle Sound Observing System. This is being done in collaboration with CSI, ECU, and Elizabeth City State University (ECSU). It will measure meteorology, waves, bottom currents, and water quality. It was just completed on Friday (April 25). It is mounted on an aid to navigation. The data will be online shortly. It has a cellular modem link to the base station. They are really excited about this project.

Dean asked how the precise location of that station was determined, and whether it was lined up with the offshore stations. Jeff indicated it wasn't lined up. It was selected to give a good assessment of open sound environmental conditions, for waves, and also because it had a good platform. Nancy noted that they also considered their ability to monitor at the site. Jeff indicated he would like to add another station at another site in western Albemarle Sound, to enable better comparison.

They are doing Regional Observations with NC-EONS and [Caro-COOPS](#), in cooperation with South Carolina. Jeff noted that these are all disparate data projects, and have disparate data networks. The concept is that all of these be brought together in a common format. The Carolinas RCOOS will bring all of these together, into a common system, funded by NOAA. The NOAA vision is they will do these all along the coast, and NOAA will be able to join them all together. In South Carolina, the University of South Carolina will be hosting the common database for all the information. Jeff noted the ACE is interested in developing better numerical models, and to do so one needs a one-stop shop for data.

MORPHOS seeks to couple the waves, circulation, sediment and atmosphere together. The mission is to develop, verify and apply a physics-based coastal and estuarine simulation and prediction capability with emphasis on storm-driven events. There are many partners but the ACE runs the program. Jeff will meet with the steering group in New York City next week. The Research and Develop component will develop and validate the model. Ultimately the goal is to produce a suite of community tools to aid in conducting risk assessments, and designing projects.

Jeff shared the partners on the team. It is a \$3.5-million program, for a three-year period and it can be renewed.

Jeff shared details of the current coastal response modeling. There is a risk/climate model, fed by historical storm data, which outputs storm parameters, tracks, intensity, size, and probability to a meteorology model, which predicts basin winds, and regional winds, which feed to basin and regional wave models, which in turn feed a regional circulation model and in turn it feeds water levels, surge, nearshore processes, ecosystem processes, and enables assessment of morphology and environmental quality changes.

The heart of the model is Rick Luettich's coastal storm surge model. The model is continually being improved. Coupling is being improved. Jeff showed us the result from Hurricane Katrina. Observed versus predicted water levels fit the model pretty well.

Jeff showed us some applications. They are involved with the state of North Carolina in the Floodplain Mapping Program. There is a large team working on this. The system is being run using a whole suite of hypothetical hurricanes, a very high-resolution topo/bathymetry grid, and other tools.

They have brought together all the data to produce a high-quality 10-m resolution topo/bathy database. The resolution is remarkable. The question was asked how this one differs from NOAA's CCAST database. Jeff noted that it was more recent, using a lot of new data.

Jud asked for the vertical resolution. Jeff didn't know. Jud asked what the contours are vertically. Jeff indicated it is on a centimeter scale, but he didn't know what it was. The topo part is all LIDAR, but the bathy part comes from other sources.

They extract an V8o_7 ADCIRC grid from all the data. Jeff showed some of the detail in the grid. There are lots and lots, millions, of data points in the model. Jeff showed us the North Carolina Floodplain Mapping Program model, developed by RENCi. The model is run thousands of times, with simulated storm tracks. 100-year and 500-year return levels to generate flood maps.

In FEMA Region III, they have been asked to apply the same approach, and are working on that project.

Another interesting project and more close to home, is nearshore wave modeling being done in

cooperation with the National Weather Service. They are working with Newport, Morehead City and one other municipality. They are providing them with a numerical wave forecast model. They are assessing the performance of the model now. The web sites are available for the SWAN. It provides a lot of detail. Jeff showed us some example output, which is predicting 2-3 foot waves tomorrow in Pamlico Sound. You can generate forecast tables for various stations. So now, we have model output and real-time data from the station in Pamlico Sound. Since January 2007 the actual data agree very well with the model. There has been no validation of the model in the sound, so they are excited about that. They have put in a proposal for five wave-validation stations in the Chesapeake Bay but it didn't fly.

The idea now is to take this really exciting coastline and make it a natural laboratory for developing models. There are high-quality measurements being made which support the RCOOS Data Bank. Once the model makes a prediction, it must be compared with data to see how well it does. The model is going to use the RCOOS data bank to see how well the predictive component works.

Wilson asked about the possibility of placing VR2 acoustic receivers on the ACE facility. He explained that he was working with Dr. Roger Rulifson and students at ECU on this project, which will hopefully be tracking fish off the North Carolina coast. Jeff indicated they would be interested.

11:18 AM: Open Topic Discussion: STAC Co-Chairs Elect Tim Spruill and Wilson Laney: Tim led the discussion and Wilson continued to take notes. Tim noted the floor is wide open for discussion. Members were provided the option to talk about the issue papers or other topics. Tim noted that he would just stand there and listen to ideas, unless Dean had something more specific in mind.

Dean noted that we had set an hour for this discussion. He noted that we could have a STAC retreat at a later date to discuss ideas. He noted that Wilson had suggested as well that we might want to have a joint retreat with the APNEP Management Advisory Committee (MAC). Dean noted that by scheduling this discussion he primarily wanted to give the Co-Chairs Elect, as well as the new Executive Board, some idea of where Committee members want to go from here.

Tim noted that we had spent a lot of time putting together parameters to model, and have gone into gory detail about how that should be done, so how do we want to take this further. Another aspect is to update the Comprehensive Conservation Management Plan (CCMP), which was released in 1994. Dean noted the first-ever CCMP revision is underway. There is a CCMP Steering Committee, composed of representatives from the STAC (members Havens and Smutko), MAC, Citizens Advisory Committee (CAC) and Policy Board. It was formed in fall 2007. Dean noted that the Monitoring Teams we have started, with Wilson heading the Living Aquatic Resources (LAR) team, will be feeding technical data to assist the Steering Committee. The original CCMP was supported by an assessment, which took all the information and assessed it. There hasn't been follow-up assessment since the initial effort in the early 1990s, so we are in the process of doing so, using these STAC-plus monitoring teams, to collect the

information on what is going on. We began with the LAR because the CCMP Steering Committee wanted to do that theme first. The CCMP Steering Committee plans to address the Water Quality theme second, so the Water Quality Monitoring Team will soon be assembled, led by Marty Lebo. The other themes and monitoring teams will follow suit. This will be sort of a pseudo-assessment. At the same time, the Policy Board yesterday approved doing a pilot assessment, in partnership with Virginia and North Carolina. Dean couldn't say at this early stage what metrics will be involved. The point is that planning is underway.

Tim asked what is the STAC role in that process. He clarified that during the early years of the Albemarle-Pamlico Estuarine Study (APES) there was a lot of money. He asked what the situation is now. What is the impetus to get these things done, at the state level? How does it all fit together?

Dean indicated that we are trying to design a monitoring infrastructure, to support planning. There is a cycle of management, implementation, assessment and feedback. In his view, the current "big APNEP" (APNEP, DENR, and other partner organizations) is already monitoring. What we are trying to do is to determine from the policy makers, what questions they want answered, and also point out any disconnect between existing monitoring and the questions.

Bill noted there essentially are no funds now. We have to approach the agencies, state and federal, and ask them what they are doing, and how they get answers. Bill noted that we are finding some problems on which we will have to work with the Secretary's Office. Some people are entrenched in the way they do things.

Tim asked if the STAC has an opportunity to provide products analyzing what we think should be done. Will the STAC subcommittee do this, or are we encouraging this be done at the state level? How does that all fit together?

Dean stated that we are not like the models of the larger programs, like Chesapeake Bay, where they have lots of in-program staff. Dean is the sole science staffer for "little APNEP." He noted that a lot depends on the generosity of the committee members, if it is going to go forward in a value-added way.

Bill noted there is also opportunity for us to ask for funds from EPA. They throw a lot of funding at contracts. They often don't tell us what they can do, unless we ask. They may put a contractor on the problems, plus the states.

Wilson noted that we are in a good place, at a good time. He shared several programs into which we can tap, such as the FWS Strategic Habitat Conservation initiative; the Roanoke-Tar-Neuse-Cape Fear Resource Conservation Initiative; the USGS GAP program, and others. He noted also that the South Atlantic Fishery Management Council is working on an ecosystem-based Fishery Management Plan that could also be beneficial. The point is that there are a lot of other initiatives, many of them within the boundaries of the APNEP region, with which we should be able to partner and possibly leverage funding. [Note: There is also need to discuss the potential

for funding through the National Fish Habitat Partnerships, both the Southeast Aquatic Resources Partnership and the Atlantic Coast Fish Habitat Partnership.]

Tim noted that climate change could be a big driver as well. Bill noted that another program which could provide up to \$60,000 is the Climate-Ready Estuaries program. He noted that he doesn't like the name, but would be pleased to have the funding. [Note: After this meeting concluded, APNEP was informed that it will be one of the EPA's Climate Ready Estuaries]. He noted that he participated in a workshop a number of weeks ago, which looked at climate change. He noted that climate change wasn't even addressed in the past CCMP. Next year APNEP will be reviewed by EPA's National Estuary Program, and one thing they will examine is what sort of research in which we are participating. Bill noted that it might be good to have them observe a STAC meeting, and have the STAC tell them what the issues are.

Dean asked Kirk to brief members on the Policy Board meeting yesterday, including the presentation of STAC technical issue papers. Dean noted that the STAC target was initially on indicator development, then on the technical issue papers. He asked Kirk to address what is going to happen to the first five papers. Then, we need to discuss topics for subsequent papers. He noted the Policy Board thought the first five that were presented were the top priority, but Dean noted the first five were done more based on member interest, rather than priority. He suggested that the STAC address the remaining issues, and decide which ones were priority.

Tim asked if we had papers on the other topics.

Dean noted the STAC had broken into three teams, and produced the papers. Other than individual member interest, he didn't really know other selection factors that determined the five topics. Regarding other possible STAC activities, he noted that during past STAC discussions of indicators and metrics there was suggestions about taking better advantage of remote sensing technologies, so one thing the STAC could do is to sponsor a thematic workshop to discuss how the monitoring might be done. Another idea is to have a regional, biennial conference, sort of a state of the science conference for the Albemarle-Pamlico Region. We could bring folks together, and share ideas and information.

Kirk indicated that the Policy Board hadn't had time to read the papers. They are reading them now. They didn't know what to do with them at the point they got them. If we want them to do something with them, we could pick topics the STAC believes are pertinent, and then produce a paper for the responsible agency, in addressing the emerging issue. We could then ask the agency to come back and report to us, say a year later. Kirk noted that he didn't want to get in the trap of producing things that no one ever does anything with.

Tim noted that we have no clout, since we are just advisory. He noted that we just generate issues we as scientists think are important. Some of the other issues didn't make the first round. We need to determine how to do this in an efficient way. Tim asked if anything resonated with Policy Board members.

Kirk stated again they really hadn't read them. He suggested we will get some meaningful input in a few weeks. He noted that we could put together a proposal for a regional conference and ask for their feedback.

Bill noted they really weren't prepared to respond yesterday. Nancy noted if we are going to take serious positions on issues, they have to be sent to the Policy Board at least two weeks in advance. Bill noted the Policy Board will respond the way they want to respond, but the STAC can also take action and make recommendations. Bill noted that there is money in the budget. We can raise the level of awareness among the state agencies by having workshops and conferences.

Nancy noted there are smart people in this room that can make sure the papers are reviewed and well-constructed.

Bill noted that once the papers are issued, the STAC's work isn't done. So, what do we do next?

Someone suggested that we should have a better process for producing the papers. He suggested, as a first step, prioritizing the remaining issues. Tim was motivated to produce the first three papers, and had the time to do so. For the group as a whole, that is not the best way to proceed.

Tim noted that he has a great situation, because he is retired and has the time. Time is the problem. As a committee, committees are always a bit of a pain, because we all have other things to do, but this one is important and extremely worthwhile. Everyone will have to take on the papers. We have to make sure we get them done, and then come back and meet as subcommittees, review the papers, and then have a discussion session. Something along those lines should be done before we move them forward.

Bill suggested the STAC revisit the original topics, and prioritize them, and select the next three to five papers to produce. We can then decide on the process. Bill noted that the staffing hasn't really caught up with the STAC yet. The STAC was out front. He is really appreciative of the effort the STAC puts into their work.

Jud noted that one interesting thing with regard to the papers handed off to the Policy Board, it might be worth the effort to cultivate out a response. He suggested that we take the one that might have been the highest priority for the group, and evaluate how the Policy Board responds. The STAC shouldn't allow them to fall into a black hole. The process has been executed to that point so the STAC should either follow through or pull back.

Dean noted that a new STAC Executive Board will be put together this summer. APNEP staff will give them the feedback on all five papers at that meeting. Jud noted that someone made the comment previously, that they didn't know what to do with the papers. If we deliver them to a group like that, we should give them some radar guidance as to what to do with them, otherwise they may fall off the table.

Kirk indicated they did receive some guidance. It was suggested that the two secretaries, from North Carolina and Virginia, could distribute them as they saw fit.

Tim noted that there are some other issues that may have come up which the STAC may not have addressed. One such issue is biofuels. It shifts things to highly polluting fuels which will have an impact on water quality, deposition, and everything else. He noted that you can relate changes in water quality in the Tar River to changes in agriculture crops. Now with acreage going back into corn with that crop's high nutrient requirements, things are going to get worse. If we thought things were bad in the 1980's, they are likely going to be worse.

Tim suggested that we break for lunch.

Bill noted that with Joan Giordano's retirement, he and Dean are now arranging lunch and it will be difficult to retain Joan's high standards. Dean asked that attendees all sign the meeting sign-in sheet. Also STAC members were asked to pose for a group photo, by which time lunch should be here. Nancy suggested a brief break would be good. Dean asked that we reconvene at 12:45 back in the auditorium.

11:57 AM: Photographs, Lunch, Networking

12:48 PM: Fecal Coliform Export in Bogue Sound Watersheds: Nancy White:

Dean reconvened the meeting. Nancy noted that she, Kirk, and Marty had a follow-up conversation to our brainstorming session. She has been asked to convene expert committees several times during the last couple of years. They have usually been tasked with issuing a white paper, after 8-9 months. She noted the STAC is an already-convened group of experts, who already have a lot of knowledge. She noted that the STAC might want to brainstorm with the Policy Board because that is where the charge will come from, and then select the top two to three issues and develop really rigorous white papers on those. If the Policy Board is part of the process, they should already be engaged. Kirk noted that the STAC also has the ability to reach into the community of scientists, and solicit them to assist us. Marty indicated the perspective he would add is that if we want our voice to be heard, we have to be selective. If we create a whole stack of them, and two or three are most important, they may get lost in the stack. Also, Marty noted to get the attention of the business community something has to be important enough to get them information, for them to engage. Bill recommended that we include the MAC as well, because they are already engaged. Nancy thought that would be great.

Dean noted that he and Wilson were talking about having a retreat, with both the management folks and the science folks, to work on the prioritization. Nancy asked that STAC members think on it, stew on it, and send any ideas to Dean. She noted that we have been down this road before but we need more rigor and thought. She noted that many of us have served on review panels before and their strength is in the rigor. She noted that with the people in this room focusing on few things could be really dynamic.

Nancy gave her presentation on fecal coliform export. She noted that we should avoid any jokes about bacteria after lunch. She noted that she has been in this business since 1999, and has heard every bacterial joke in the world. Someone asked her to tell one, but she demurred.

Nancy indicated that she had provided us with a summary of the new paper¹ that she and co-authors have just published. She and Bill Kirby-Smith were driving around, a number of years ago, looking for a small watershed with a closed shellfish bed. They found Jump and Run Creek, where the shellfish bed has been closed since 1974. They began by doing a watershed survey. A big surprise was they found no failing septic tanks. They did find lots of domestic animals, including one lady living in a trailer with 39 cats. They found things like a dog kennel, flushing the wastes into the creek, but all the sources didn't add up. They instrumented the watershed. They did flow proportional sampling. They set their gear up in 1995, and there were six named storms that year, which kept filling up their bottles. Everything that first year went wrong. They did manage eventually to put together four years of good data. They also were able to add the Croatan National Forest as a baseline area. They also sampled Open Grounds Farm. They just put Pettiford Forest and Jump and Run Creek in the paper. The bacterial loading is so high that it really begs the question as to how to fix the loading problem. There was no correlation between bacterial loading and impervious surfaces, and other factors, except for rainfall. It is really going to be difficult to manage stormwater if bacteria is the criterion for success. Some of the watersheds they measured have really low human density and low areas of impervious surface. There are just a few exceptions to the lack of point sources. Nancy indicated that she would like to have an open dialog with the STAC about coastal storm water. She asked that we read the paper and then share any ideas with her.

Stan Riggs asked what the new coastal stormwater regulations are. Nancy stated that anything within a half-mile has to be developed under the new standards of 12 percent impervious. Wetlands are taken out of the lot calculation. Buffers within a half-mile have to be 50 feet.

Stan asked if there was any relationship between loading and duration of the rainfall event. There wasn't, Nancy advised. It might come in waves, but it loads for the duration of the storm event. From the industrial watershed annual export was over 76,000 NPN/ha. Those are really high numbers. Nancy noted that she had previously done a paper that looked at land use, and the only positive correlation she found there was related to the ditches. Nancy noted that one theory is that the ditches serve as pipelines for bacteria from wildlife. She noted that the hydrology is so complex in coastal watersheds that all the bacteria, from all the sources, co-mingle and swap DNA so that by the time they are sampled they all look the same. For DNA ribotyping, you have to have a huge library for your control, that it is cost and time prohibitive. You would need tens of thousands of samples on which to match. Nancy stated that using antibiotics and trying to get any isolate to respond didn't really work either. They were never able to quantitatively identify the source of the bacteria in Jump and Run Creek. There was some indication that septage did enter the picture, at least from the near-surface area. Some do derive from wildlife that are living

¹ Line D.E., N.M. White, W.W. Kirby-Smith, J.D. Potts. 2008. Fecal coliform export from four coastal Carolina areas. *J Amer Wat Resour Assoc* 44(3):1-12.

in the creeks. Stan indicated that was a pretty dismal picture. Enrique suggested removing the wildlife.

Nancy noted that STAC member Barbara Doll had suggested plugging the ditches. The volume and speed of the water must be reduced to allow the bacteria to die off. We are going to have to move away from lot-scale stormwater management and look at things on a community and landscape scale. Nancy noted that the ditches started with the forestry people a long time ago, then the farmers came in and ditched, then the residential areas. Almost no water was being sequestered in the landscape. It used to be that about 80 percent was processed by evaporation, but now 80 percent goes to runoff.

Tim noted that for a lot of crops, you can't farm without ditches. Zoning is something then that must be considered. You can use BMPs, but at some point you have to stop development.

Nancy stated the CAMA regulations that promoted low-density development are part of the problem, because people just platted things out and moved sideways. She didn't know that people would have put houses on the high ground, but CAMA did promote sprawl. Now, we are promoting this type of development in Hyde and Tyrrell Counties. Using bacteria as a criterion may be part of the problem. She noted the communities all like the concept of low density. Development needs to be managed so that it is in the right place. We should not build at all in some locations, but that cow is already out of the barn. Nancy noted that Southern Shores had done a mapping study that mapped over 300 microscale watersheds, and now they are putting some of them into urban parks and other uses. She felt that is the way we will have to go. There is a workshop tomorrow that will be looking at how to do some of these things. Bill noted APNEP is a co-sponsor and all the attendees are elected officials. Nancy noted that we are going to have to manage on a local scale. She noted that she had told one local mayor not too long ago that if they managed for their flooding problems, their water quality problems would be solved as well. Someone stated it will all be under water soon anyway. Nancy joked that we could hope that would be the case. Nancy noted that she would appreciate any thoughts that we had. She noted that one pathogen they have found ubiquitous is Salmonella, which is coming from turtles. Wilson noted that is why pet-store turtles were banned. Nancy noted there is a technique now which can differentiate human-derived bacteria. She works mostly on the landscape and water issues, and believes the only solution is to get more trees back in the landscape.

Tim asked if the authors made recommendations at the end of the paper. Nancy indicated that Dan did most of the writing, since she was doing largely administrative work for the last two years. She noted that Dan put in the classic statement at the end of the paper, which is that more research is needed. Nancy noted again that most of the bacteria comes from wildlife, so the issue is really delivery. She stated that we are going to have to find a better way of moving the water. She noted that Open Grounds is doing a pretty good job of managing their water, using created wetlands and so forth.

1:15 PM: Coastal Submerged Aquatic Vegetation Mapping in Coastal North Carolina and Southeastern Virginia: Don Field:

Don noted that his name is on the presentation, but there are a lot of other people who worked on it. Don noted that he was more of a remote-sensing geek, and would move right into that pretty much. He noted that Liz Noble at ECSU began the effort, with funding from FWS. The first aerial surveys were done in 2003. Don reviewed briefly the agencies and institutions involved in the partnership.

He noted the objectives of the [SAV Partnership](#) are monitoring and mapping, assessment and restoration, and policy and outreach.

The monitoring and mapping objective is to monitor and map the distribution and abundance of SAV in North Carolina and southeastern Virginia estuarine and coastal waters. The initial target area covered from Back Bay through Kitty Hawk Bay. The intent now is to cover the rest of the state. Don noted that remote-sensing is very cost-effective, looking at the area covered per unit time, but the imagery is expensive. The long-term objective is to institutionalize the program so that monitoring and mapping will be ongoing.

Don reviewed the pre-2007 aerial monitoring activities. Back Bay and Currituck Sound were monitored October 2003, and mapped in 2006. Pea Island NWR was monitored in June 2004 and mapped 2007-2008.

Don reviewed the 2007 monitoring activities. Resources used included APNEP, FWS and NC-DMF. The contract was let to NOAA through an IDIQ contract mechanism. Flights were done by Aerometric, and Dewberry provided quality control. Doing the entire North Carolina coast was a monumental effort. There was a huge network of water clarity volunteers, coordinated in part by Scott Chappell of NC-DMF. Twenty five citizens went out and took Secchi depth data and others provided ground-truth data.

Image acquisition was done using a Zeiss Digital Mapping Camera System, flown 24,000 feet above the mean terrain (1' = 5,080 feet). There is sub-meter raw native pixel resolution. The sun angle has to be 25-45, wind less than 10 mph, done at low-tide (polyhaline). Don noted if everything works right, you can process the data in a month, for a small area. The DVD's were delivered and he could put them right into ArcGIS.

Don showed us the flight lines for the autumn 2007 aerial monitoring. There were 1,795.45 flight line miles targeted. Oligohaline waters were priority. 1,637.71 miles were captured. Ninety-eight percent of the 1,494 targeted field points were ground-truthed. There were 650 polyhaline points, 85 mesohaline points, and 759 oligohaline points. Brian Conrad of NC-DMF did a fantastic job coordinating all the volunteers.

Don reviewed the environmental parameters for submerged habitat mapping. Winds have to be low, preferably five mph or less, low sun angle to reduce glint, low tide, low turbidity, no clouds

and haze, and adequate biomass of target. Don noted the drought last year helped a great deal in keeping sediment loads at a minimum and hence reducing turbidity.

Don showed us a scanned image of Harkers Island. He showed us a camera setup, which costs \$1.5 million. Don noted they just took delivery for Bogue Sound and Core Sound which were flown last fall. When they fly higher they can get a lot done in a day. Don showed us Drum Inlet. He stated the wind was a little too high. Despite that fact, the imagery looked pretty good. You could easily see the seagrasses on the imagery. Unfortunately, some of the other imagery has too many whitecaps. The wind exceeded the preferred level. Some of the Currituck Sound imagery may be compromised by turbidity in the water. For some of the Albemarle Sound imagery the seagrass edge is difficult to ascertain. Don indicated that for some of the imagery you can use stereo pairs of images if you have the right software. The company will put the images in tiles, but then you have to deal with the seam lines when working in water. Don had hoped the seam line issues would be less given the cameras being so much longer. Again, they just took delivery on the imagery last week. Some of it looks very good. On other images, the water quality will cause problems. The camera has four bands: band 1 is blue, band 2 is green, band 3 is red, and band 4 is near-infrared. The latter one is good for mapping shoreline and marsh habitats. There are a lot more applications than just the seagrass issue.

Don showed us some of the types of changes and issues he has seen thus far. He showed a section of Intracoastal Waterway in 1992, then 2006, with adjacent seagrass beds which have disappeared. Where there was dense seagrass in 1992 there is very little in 2006. Don showed us some other images of the same phenomenon, which he takes as indicative of high-energy conditions leading to the disappearance of the grass. He showed us a site off Harkers Island in 1992 again showing loss of seagrass. He noted a problem one always will face with seagrass images is that anniversary dates are rare because of the flying schedule. So the analyst may be looking at density differences rather than seasons, but in these cases he didn't believe that was the case.

Don noted that one big surprise, looking at Middle Marsh where he cobia fishes, is that the channel in 1992 versus 2006 had consumed 26 meters of marsh. Most of the marshes in Core and Bogue Sound were flown so that will yield a lot of good data. Don showed us another 1992 aerial image in an area where he deems boat wakes to have been a problem. The corresponding 2006 images show a tremendous amount of development.

For 2008 Don noted that there will be some spring monitoring, for 157.77 flight line miles. Mapping is occurring. Field monitoring planning is underway. They are looking for more resources for 2009.

Don explained why both monitoring and mapping are needed. Turbidity makes it hard to visualize SAV even on the best days, because boat wakes may kick it up and obscure the beds. Biomass can be large and there can be differences for many reasons. Change detection with monitoring can improve habitat classification over time. Don noted the maps can be updated based on monitoring efforts, or ground-truthing of questionable sites. The maps are continually

being improved.

Don showed the advantage of building up a photo library. He showed a 1988 image of Drum Inlet. In 1992 the shape of the inlet had changed. In 1998 NC-DOT photos the inlet had narrowed more. Hurricanes Dennis and Ophelia opened up several new inlets. Old Drum Inlet re-opened. The area is very dynamic and beautiful. Don showed us a red drum that he had caught at his favorite fishing spot.

Tim asked who does the causal analysis. Don indicated that causal is difficult when the images are 15 years apart. He noted that some are easy to pinpoint. Others are uncertain. Don noted the sad truth is that we have done this so seldom, it will be impossible to assign causes for changes. What he has seen thus far is that Bogue and Core Sounds were different. But in some cases you can drop the same polygon over the 1992 imagery and they will be the same. Out near the inlet there seems to have been an expansion of seagrass, but Don can't be sure.

Tim asked who the primary data users are. Don noted that Dean and Bill and the APNEP program were the original users. He noted the question was a good one. Don noted that having a map can be dangerous when the grasses are really seasonal. Some believe that you are better off not to have a map since that won't prejudice your determination. Wilson noted that they are used a lot in regulatory review processes, but you shouldn't presume that SAV isn't there if it isn't on the map or in the image. Nancy noted the data are used for the CHPP as well. Don noted that a lot of the photos were heavily used, and many of them have walked off, so he doesn't have them to scan.

Stan Riggs indicated that they see bedforms during most of the year that are bound by algae, and some of them can be tracked back to 1939, to the first aerial images. But they can be broken up by major storms. Once they form, they semi-stabilize until the next big storm.

Don noted that some of the ones in Bogue Sound haven't changed much. Stan noted there are some incredible algal habitats present that haven't been studied much.

**2:00 PM: Coastal Submerged Aquatic Vegetation Monitoring Program for APNEP Region:
Jud Kenworthy:**

Jud noted that maps can be an excellent tool to visualize the resource, but we need a program sensitive enough to detect change. He noted that Don's presentation shows us how difficult it is to acquire the imagery, analyze it, and then do it on a regular basis.

Jud talked about establishing a framework for a statewide, in-situ monitoring program for North Carolina. This would be a long-term, persistent program for sampling on a persistent basis. Jud noted that he was going to illustrate some examples of existing monitoring programs around the world, and tell us what such a program based on his recommendations will cost. He will provide some background as to why we should monitor.

Jud noted that monitoring will allow us to inventory species abundance and distribution, and detect the status and trend of the resource. We can also link status and trends to cause and effects. It is a paramount management tool, if we can get all that together. Jud noted that monitoring is the apex of a triangle, with mapping and modeling being the other two corners of the triangle. Jud argued that what we should be mapping is where we think seagrasses should be. He argued that our data are good enough now, such that we can do that using the bathymetry. He advocated doing that rather than mapping presence or absence. Jud noted that we need performance measures. We need one we can quantify and use to detect change. It likely has to be based on a probabilistic approach. One example could be a change of twenty percent in ten years. Jud noted that we can monitor more than SAV. The SAV are excellent bioindicators of the environment. They integrate sunlight, organisms that use them, they have widespread distributions, they are responsive to perturbations, they integrate environmental conditions, and play an important ecological role. They produce cascading effects when they change.

Jud noted there is one thing people overlook about SAV. They are complex organisms and don't necessarily respond to the environment in an immediately obvious way. When they are stressed they don't necessarily respond immediately. They can be stressed for months, years, or even a decade, before they respond. Jud showed us a diagram that illustrated that point. The plants are clonal and can move resources around. You may not see a SAV bed go from lush to sparse in a short period of time. A lot can happen between the periodic monitoring by aerial images. You have to have a sensitive monitoring program. If you wait until you see change, it will usually be too late. The programs need to be sensitive enough to pick up the stress factors early. We have to have a monitoring system sensitive enough to capture the changes.

Jud showed us photo which depicted the sense of urgency that he wanted to convey. He was part of a group that compiled about 470 monitoring programs (the paper is in Bioscience, 2006). Jud noted that most of the research monitoring programs showed that a good percentage of the SAV was decreasing through time. The rate of decrease is accelerating as we get closer to the present. As we move forward from 1880 we are actually seeing areas where SAV is declining at an annual rate of over thirty percent. In the last ten years they have seen entire estuaries in Massachusetts lose all the SAV cover. There were only about 23 percent that are increasing in the most recent data sets. On a regional scale, Bob Orth reported for the Chesapeake Bay that decreases are significant. For North Carolina, we don't have a clue what is happening.

Jed shared some basic facts. If you Google SAV in North Carolina, you will find the number 200,000 acres. Jud stated there are no data to support that figure. The CHPP cites a paper Don did, which doesn't have that number. Jud noted that even Bob Orth cites that number. The 2-m contour contains 679,746 acres of water, so Jud noted that the number may be pretty good, since some of the best SAV systems exhibit about 30 percent cover. Some of the numbers in the CHPP came from work done by Randy Ferguson. That is the great myth for SAV in North Carolina. We don't really know how much is out there.

Jud noted a headline from the Wilmington Star which stated that "improving outlook for seagrass could complicate development of some waterfront properties." Jud noted that one of the CAMA

staff stated that whether the grasses are recolonizing old habitat, or expanding their range, and why, isn't entirely understood by researchers. Jud stated that isn't true. We understand why they do what they are doing. He noted the erroneous headline went all around the world and he received numerous calls about it from colleagues wanting to know what was happening in North Carolina.

Jud shared a table of continuously-funded long-term SAV monitoring programs. There are only a handful of them: Chesapeake Bay, Massachusetts embayments, Indian River Lagoon, Florida Keys National Marine Sanctuary, Florida Bay, Puget Sound (Washington), Bermuda Benthic Habitat, Seagrass Watch, Northeast Australia, and Seagrass Net. Jud indicates in the table the type of sampling employed. The size of the areas was also reported. Jud reviewed the entire table with us. The programs range from 3 to 22 years in duration. The frequency for many of them is annual sampling. Jud noted they had just begun a program in Bermuda. He noted that transects are good, when inserted into a probabilistic design. Jud showed us the design for the Florida Keys NMS which employs tessellated hexagons for its sampling base.

Jud indicated he thought the design used by the Puget Sound program is the best fit for North Carolina. The design is probabilistic, which he indicated is good because it can be used for predictive purposes. You have to have it to detect change. Jud showed side-by-side maps of coastal North Carolina and Puget Sound in Washington State. They are similar but the barrier islands are lacking from Washington. If the barrier islands weren't there, we would have no seagrasses in North Carolina. He noted that seagrasses behind the barriers might be related to the formation of the barriers or their movement. Stan concurred they were definitely related. Jud noted that in Puget Sound the grasses follow the shoreline. Along the inner coastline the grass beds run parallel to the coast. We don't see grass beds typically growing below 2 m depth. In Puget Sound, SAV can grow up to as deep as the 20-foot contour. There is a lot more shoreline in North Carolina, between eight and twelve thousand miles. In Puget Sound the estuary is divided up into subunits. Jud noted that we could adapt that scheme to North Carolina using slightly different criteria. They ended up with a series of thousand-meter segments. They sample annually 75, 1,000-m segments. The segments are drawn from a random tool.

Jud reviewed the sampling technique used in Puget Sound. He noted the methodology was pretty well accepted and easily adapted to North Carolina. He showed a visual example. It requires about 55 days in summer to do the entire Puget Sound. Jud noted that we could develop a program like this one in North Carolina. Jud reviewed the equipment used in Puget Sound. It includes differential GPS, depth sounders, Garmin FishFinder 250, lasers, underwater light, navigation software, and a video overlay controller. The work is done using a 32-foot Grand Banks trawler. Jud noted they have to use that size vessel in Puget Sound. An 18-foot Carolina skiff could be used in North Carolina.

Jud indicated that the Puget Sound program had set their sampling program up to detect a particular percent change. Kirk asked why the error bars changed over time. Jud noted the reduction in variance was due to the improvements in the program over time.

Jud reviewed the cost of the program. Full time biologist, two technicians full time, and two part time, consulting staff, and equipment. The total annual cost for the whole program is \$692,000. Most of the cost is in a MRC contract, and staff salaries.

Jud noted that to put the cost in perspective, he had multiplied the conservative measure of existence value of SAV (\$8,000 to \$28,000 per acre) by the supposed acreage of SAV in North Carolina (the 200,000 acre figure), it is worth \$1.6 billion dollars annually. Nancy asked where the values originated. Jud and Stan explained they come from various studies. You can take a range, or use an average. To him a cost of \$600,000 year to protect a resource that produces \$1.6 billion a year, is not unreasonable. Nancy stated he should make this presentation in Raleigh.

Jud stated that a monitoring program will be an important step forward for us as stewards of the resource. He noted that we all hover around and act more like a booster club, but we need to take the plunge and move forward. Jud noted that everyone believes that habitat is important, but the fisheries agencies, state or federal, have too many other fires to fight. The problem in North Carolina is that DMF has been charged with doing this, but they have too many other issues to conduct.

Nancy asked how far out from the shoreline one would have to go to purchase all the SAV habitat. Jud noted that it is a public resource. Nancy clarified that she meant to put some sort of closure in effect, to protect it. Jud noted they are already mandated to do so in North Carolina. Nancy noted that Jud's presentation was more depressing than hers.

Dean stated he thought Anne Deaton (NC-DMF) was leading an effort to provide a more comprehensive definition of SAV, and the topic is a hot one, which is how to provide more protection for SAV.

Kirk noted that Bob Orth's data set allows you to look through time and see where SAV has been through the years.

2:44 PM: **Adjourn:** Dean thanked Nancy and Michael for their leadership during the first four years, and noted that he looks forward to the leadership of Wilson and Tim.