Statement of

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Committee on Transportation and Infrastructure
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Chairman Hunter, Ranking Member Garamendi and distinguished Members of the Subcommittee. I am Larry Mayer, a professor and Director of the School of Marine Science, Director of the Center for Coastal and Ocean Mapping, and co-director of the NOAA/UNH Joint Hydrographic Center at the University of New Hampshire. I also served as chair of the National Research Council's Committee on National Needs for Coastal Mapping and Charting and testified before the House Natural Resources' Subcommittee on Insular Affairs, Oceans and Wildlife on the outcome of that study. My testimony at that time included a discussion of several recommendations dealing with increasing the efficiency and accuracy of coastal mapping and charting activities that are particularly relevant to today's topic. Many of those recommendations have been incorporated into the Ocean and Coastal Mapping Integration Act, Subtitle B of Title XII of the Omnibus Public Land Management Act of 2009. While my comments today build on that background, they do not represent the views of the National Research Council but rather represent my views as the Director of the Center for Coastal and Ocean Mapping. In that capacity, I want to thank you for opportunity to come before you today and offer some observations on the future of maritime navigation.

The Center for Coastal and Ocean Mapping/Joint Hydrographic Center at the University of New Hampshire is a national center for excellence in ocean mapping and data visualization activities. The Centers serve NOAA, the Navy, other federal agencies, and the private sector through the development of new tools and protocols that support a range of ocean and coastal mapping activities including safe navigation. Particularly relevant to our discussion today are the efforts of our lab, in collaboration with NOAA and others, to ensure that we have the best tools possible to map hazards on the seafloor and in the water column, and that as the density and complexity of the data we collect increases, we can present this information to the mariner (and others) in a way that is easy to interpret and will assure the safest operation of vessels in all circumstances. In support of these goals, the lab has embarked on a project we call the "Chart of the Future," which aims to take advantage of the many great advances we have heard about today—advances in seafloor and shoreline mapping, positioning, water level measurements, the use of AIS and other means for two-way communication with vessels and smart buoys—and to explore how these many sources of information can be integrated and displayed in the most useful and intuitive fashion possible for the mariner (and others).

Today I would like to build on the remarks of my colleagues and, taking advantage of the tremendous infrastructure they are supporting and the data they are providing, envision what the chart of the future may look like and the services it may provide. To illustrate this I will be showing a video that captures some of the aspects of the chart of the future.. I do this to give you a tangible idea of the concepts I am describing. As you look at the video, I want to emphasize that what you are seeing is not a cartoon or artist's rendition—it is the product of real data sets collected and provided by our lab and by many of the agencies represented here today.

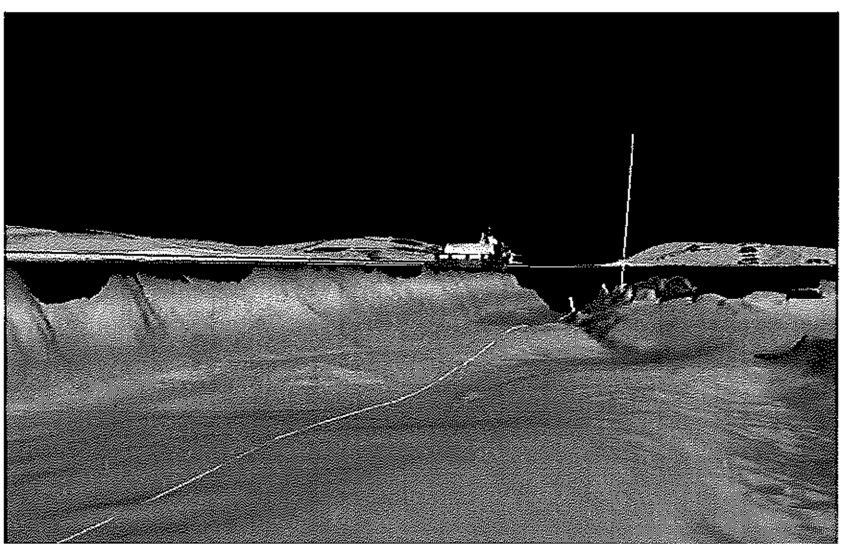

Figure 1. Navigated vessel icon depicted to scale over full-coverage 3-D bathymetry in Portsmouth Harbor

As you can see, our vision of the chart of the future seeks to provide the mariner with a complete, fully geo-referenced picture of the seafloor, the surrounding shoreline, and other relevant features in as natural and intuitive a display as possible. The chart of the future takes full advantage of the fact that our modern "multibeam" mapping systems can provide complete coverage of the seafloor rather than the sparse samples of earlier lead-lines or "single-beam" echosounders. Mariners will no longer need to mentally integrate numbers and contours displayed on charts to determine the relationship of their vessel's keel to the seafloor, but rather will be able to clearly see, in an intuitive perspective view, the relationship of the keel to the seafloor and to any existing hazards. The displays will be interactive and be able to bring in the most relevant information for the task at hand. A fishing or dredging vessel may not just want to see the 3-D depth of the seafloor but may also want to know the nature of the seafloor (rock or gravel or sand), and this information can be superimposed on the depths to provide a map of not just "where" the seafloor is but also "what" the seafloor is. From an environmental and resource perspective, information about fisheries habitat or sand or gravel resources can be superimposed on the depth information, thus providing those charged with the protection or exploitation of resources the critical information they need.

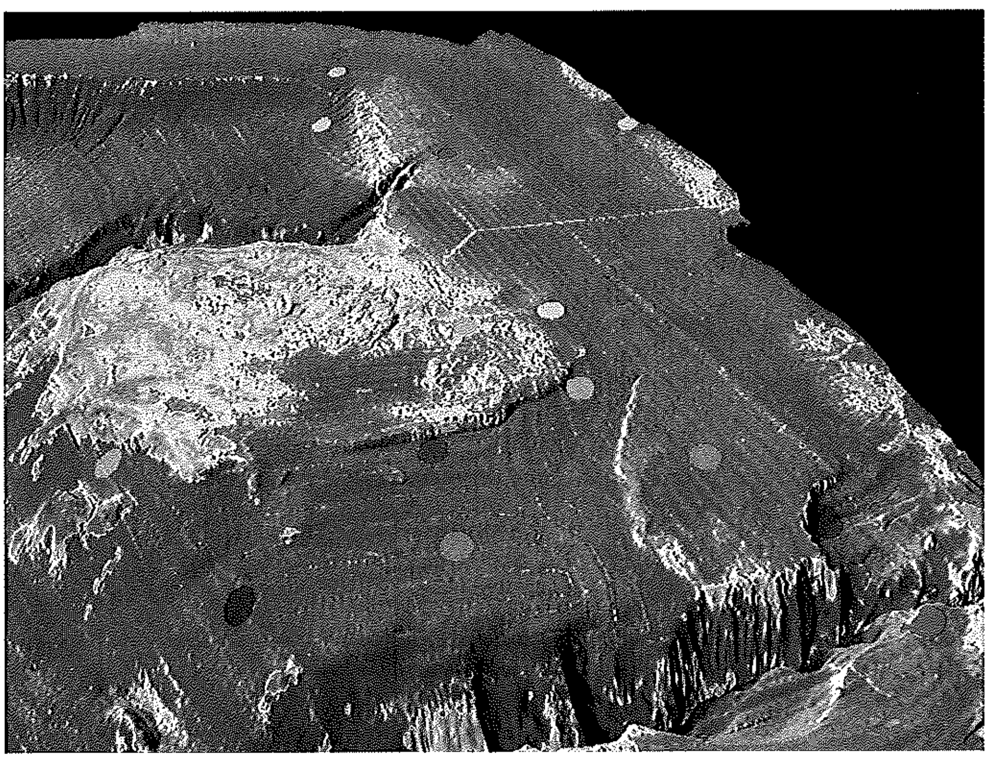

Figure 2. Seafloor characterization information draped over 3-D bathymetry. Brighter colors indicate rocks and hard outcrops, blues indicate softer sediment. A large sewer diffuser pipe is visible as thin yellow line with fork at end at upper right side of image.

While with the proper collection of data, we can map and display seafloor depths in remarkable detail, the critical issue for safe navigation is really the distance between the seafloor and the bottom of the vessel. Over most of our coast, this distance is constantly changing as the tides come in and out. Yet our charts are static products showing depths depicted in the safest way possible—for the lowest tides—which can often constrain the mariner. Instead, we envision the chart of the future as a dynamic product that is "tide-aware." The chart will receive NOAA tide data through the AIS system and update itself to display the actual under-keel clearance at a given time and location. The "tide-aware" chart can also be a very valuable tool for pre-trip planning as one could easily plan a route and clearly see where difficulties may be encountered and modify the trip-plan accordingly.

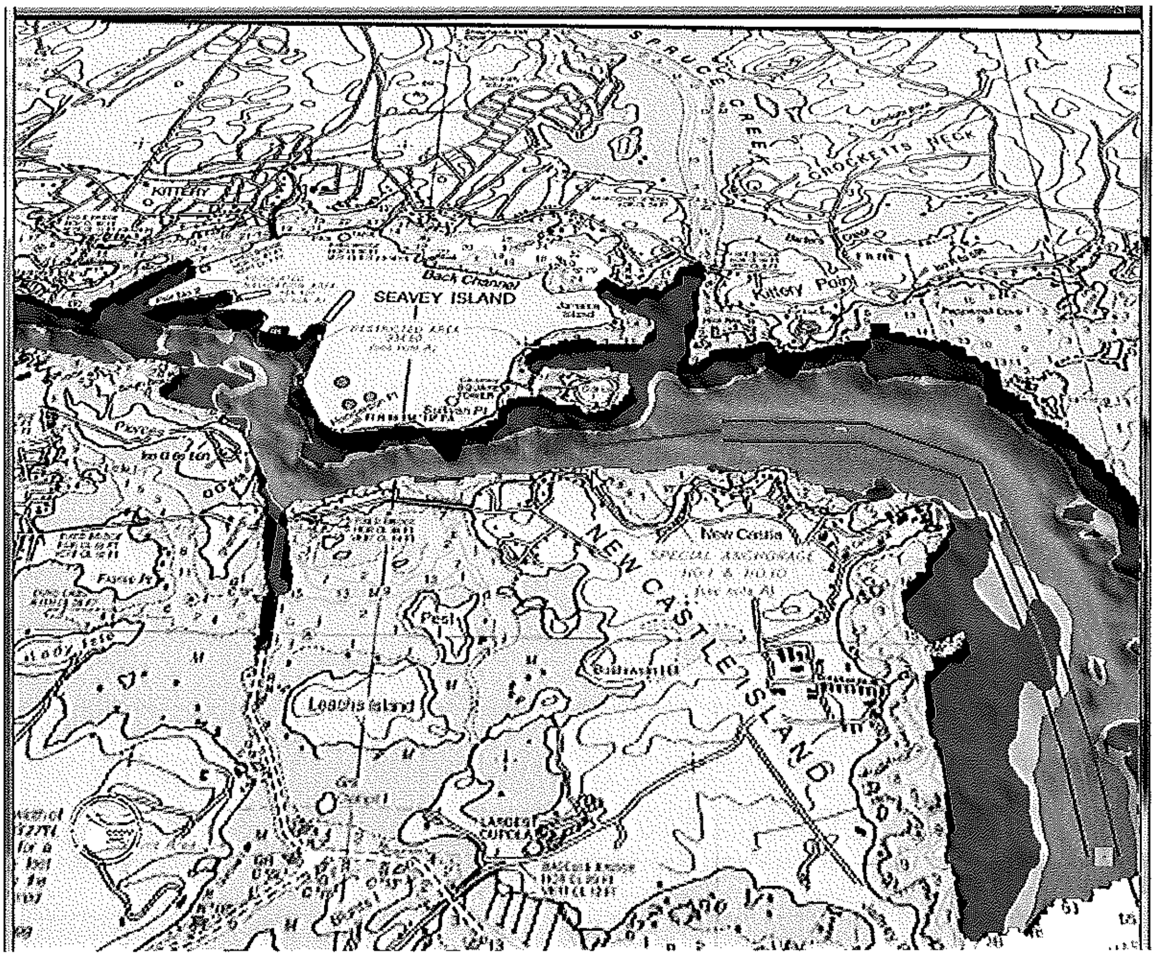

Figure 3. Example of tide aware chart in Portsmouth Harbor, N.H. Chart changes dynamically with tide information – red indicates too shallow for draft of vessel, yellow indicates caution, and green indicates safe passage. Here a route up the harbor is being planned and the under-keel clearance depicted for the time of the proposed journey.

Also critical to safe navigation is the full understanding of currents and how they will impact the vessels position and transit capabilities. We envision that the chart of the future will be able to clearly display the currents at a given time (either from models or the real-time broadcast from data buoys). With appropriate information about vessel dynamics and characteristics, software may also be able to predict what the true behavior of the vessel would be as it is impacted by the currents. GPS tracking of the vessel will verify the vessel's behavior and perhaps even upgrade the model so that future predictions will be improved. Additional layers, providing information on weather, sea-state, and, in high-latitudes, ice conditions, can also be added if necessary.

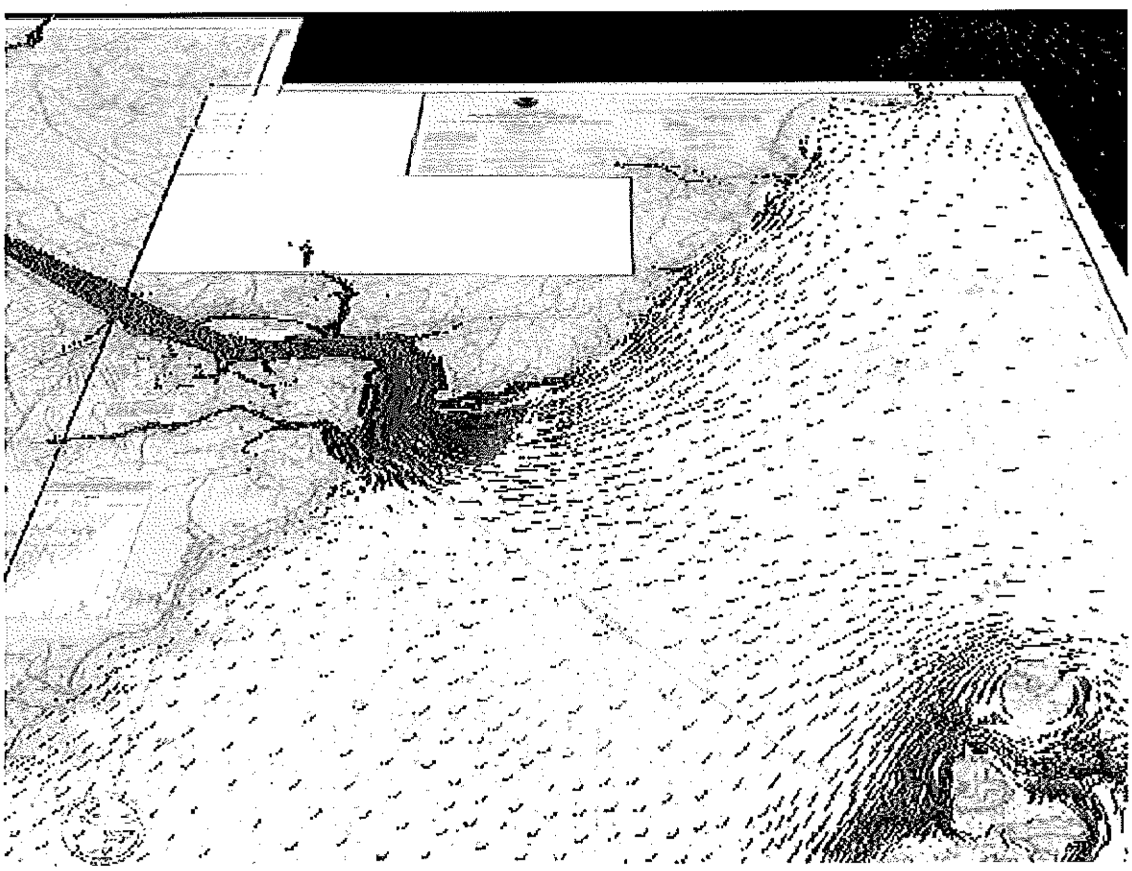

Figure 4. Streamlines depicting current information in Portsmouth Harbor. With appropriate vessel information, the behavior of the vessel can be predicted.

As a vessel enters a harbor or approaches a coast, a collection of fully geo-referenced images can be displayed in a 3-D context, creating what is, in essence, a digital 3-D Coast Pilot. A click on a feature described in the text will instantly bring up an image of that feature in the 3-D map context, and a click on the image of a feature will instantly bring up the text describing that feature. Hand-held devices can be used to point to a feature or navigation aid and instantly identify it while also providing an automated means of reporting buoys or navigation aids that may be out of position or malfunctioning.

Figure 5. Digital, 3-D display of Coast Pilot information. A click on the image of the object takes you directly to its text description – a click on the text takes you to the geo-referenced image of the object.

Finally (and I say finally only because this is as far as we have gone in our current research—the possibilities are nearly endless), we can also bring in full 360-degree panoramas of our harbors or coastlines. With these images incorporated into the chart of the future, the mariner can enter unfamiliar harbors, at night or in fog, and still see a clear picture of the surroundings. Daytime or night-time images can be interchanged so that night-time views can be compared directly to the actual features.

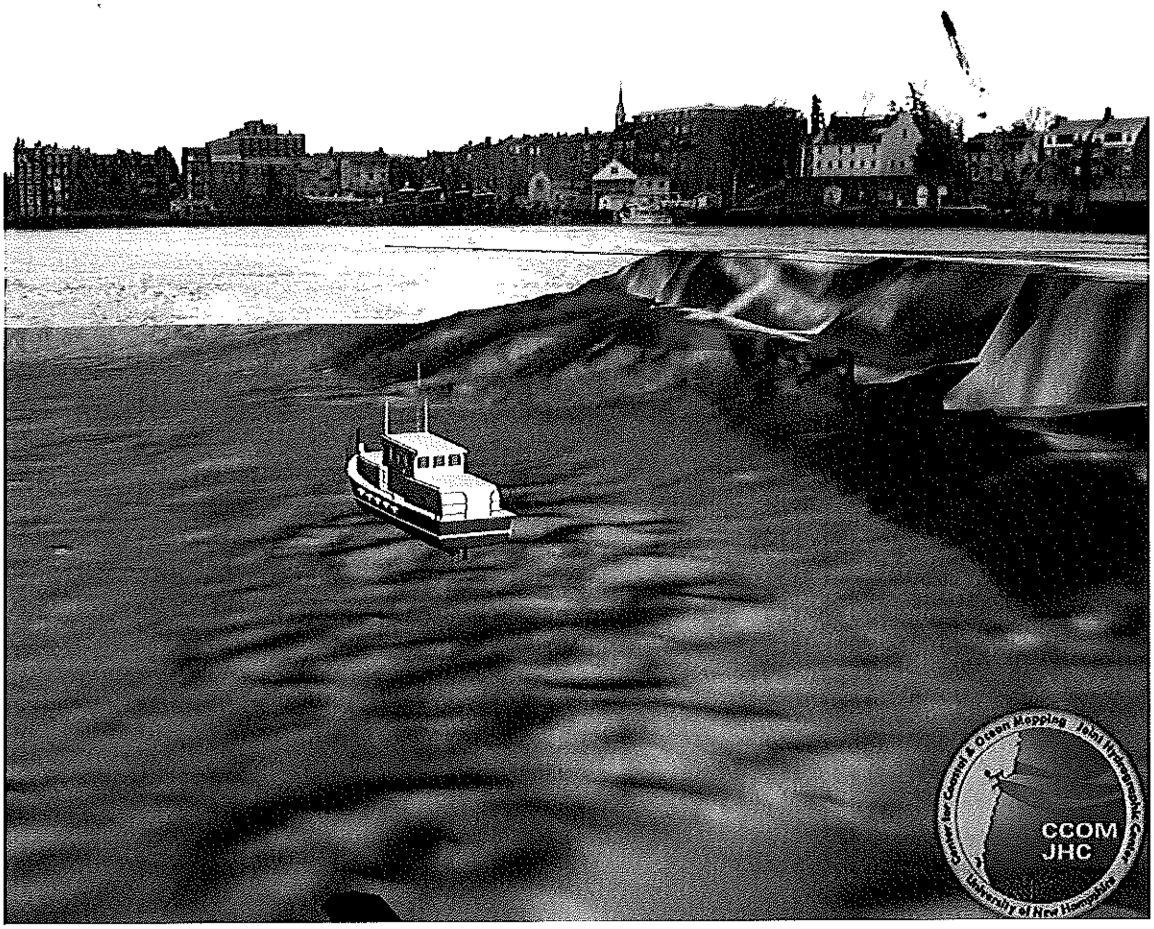

Figure 6. 360-degree panoramic images of harbor and surroundings as vessel navigates over 3-D bathymetry in Portsmouth Harbor.

I have presented our vision of the chart of the future—a vision that we believe will provide the mariner and the nation with an enhanced level of safety and security as well as support the opportunity for multiple uses of the data. What we have described is quite doable—indeed we have done it for our backyard in Portsmouth, N.H. But to make this vision a broader reality, we need to ensure that our nation continues to support and upgrade the critical infrastructure that it depends on. We must ensure the continued provision and upgrade of high-precision positioning systems and tide measurements; support of AIS and other means for real-time ship-to-shore data communication; smart buoys; and enhanced weather, wave, and current measurements. Most importantly we must strive to provide full bottom coverage mapping to our critical waterways, harbors, and coastal areas, remembering that many of these areas are dynamic and that we will also need to understand how they change with time or in response to events like Superstorm Sandy. And above all, we must ensure that the data collected are of the highest quality and meet the highest standards. If this can be done, we are confident that the future of maritime navigation will be a bright and safe one.