Written Statement of

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and

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before the

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Madam Chair, Ranking Member, and distinguished Members of the committee, I thank you for this opportunity to comment on H.R. 2400, the "*Ocean and Coastal Mapping Integration Act.*" My name is Larry Mayer. I am a professor and the Director of the Center for Coastal and Ocean Mapping/Joint Hydrographic Center at the University of New Hampshire – a national center of excellence in ocean mapping. I am also the co-chair, with Dr. Ballard, of NOAA's Ocean Exploration Advisory Working Group, but I come before you today because I served as the chair of the National Research Council's Committee on National Needs for Coastal Mapping and Charting.

As you know, the National Research Council (NRC) is the operating arm of the National Academies, chartered by Congress in 1863 to provide independent advice to the federal government on science and technology. The Committee on National Needs for Coastal Mapping and Charting was created at the request of the National Oceanic and Atmospheric Administration, the U.S. Geological Survey, and the U.S. Environmental Protection Agency and charged to identify high-priority coastal mapping needs, evaluate the potential for meeting those needs based on current levels of effort, and most importantly, suggest steps to increase collaboration and ensure that the nation's offshore mapping activities are conducted in an efficient, timely, and cost-effective manner.

Why we map the seafloor:

Let me set my remarks in context by saying a few words about the importance of coastal and ocean mapping. We are a maritime nation. We depend on the oceans and coastal zones for commerce, for food, for resources, for recreation, for regulating our

environment and climate, and for national security. Under Article 76 of the Law of the Sea Treaty, mapping can also serve to extend our sovereignty over seafloor resources far beyond our current 200 nm Exclusive Economic Zone (EEZ). Ninety-five percent of our nation's imports, by weight, are transported by sea and fourteen of the country's twenty largest urban centers are located on the coast. To assure safe navigation, to explore for, exploit and preserve our resources, to understand climate change and to protect our environment and our security, we need accurate maps of our offshore regions that tie in with the accurate maps that exist onshore.

Modern onshore mapping techniques have provided regional and even global maps and images of our planet's surface with remarkable accuracy and detail. These maps and images have revolutionized our understanding of the earth and its processes. Perspectives provided by these techniques have indeed been revolutionary, but, with most of the earth's land surface hidden beneath a thick blanket of seawater, they are only applicable to the 25% of Earth that is above sea-level. The surface of our moon and many of our sister planets and their moons, have been mapped at very high spatial resolutions (tens to hundreds of meters), while vast areas of the seafloor remain virtually unmapped.

Mapping the seafloor:

Since the earliest days of travel on the seas, the ocean depths were measured using a weight at the end of a knotted rope (a "lead line"). This tedious and often inaccurate approach remained virtually unchanged for thousands of years until sonar techniques developed during the Second World War were perfected to the point that "echo sounders" became a viable approach for mapping depths. While echo sounders greatly increased the speed at which depth soundings could be made, they still collected individual, discrete measurements of the seafloor along a single line. The maps produced were made by interpreting depth contours between relatively sparse echo sounder lines (Figure 1).

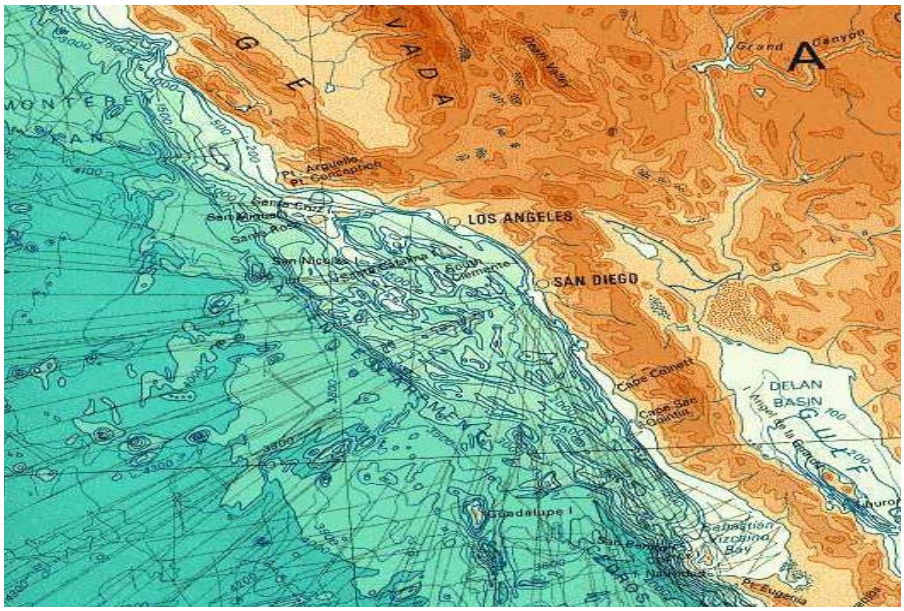

Figure 1. Map of offshore southern California based on single-beam sonar data.

Over the past few years concurrent and convergent developments in sonar technology, positioning capabilities, and computer processing power have begun to remove the technical and logistical barriers to detailed, highly accurate seafloor mapping. A new generation of "multibeam echosounders" can now provide remarkably accurate images of complete seafloor topography over broad swaths including the ability to simultaneously collect sonar "backscatter" data that offers insight into the characteristics of the seafloor (Fig 2). These offshore swath mapping techniques are similar, in concept to the high-resolution laser-based LIDAR techniques used to produce onshore topographic imagery and while they are remarkably effective, they are also complex and expensive.

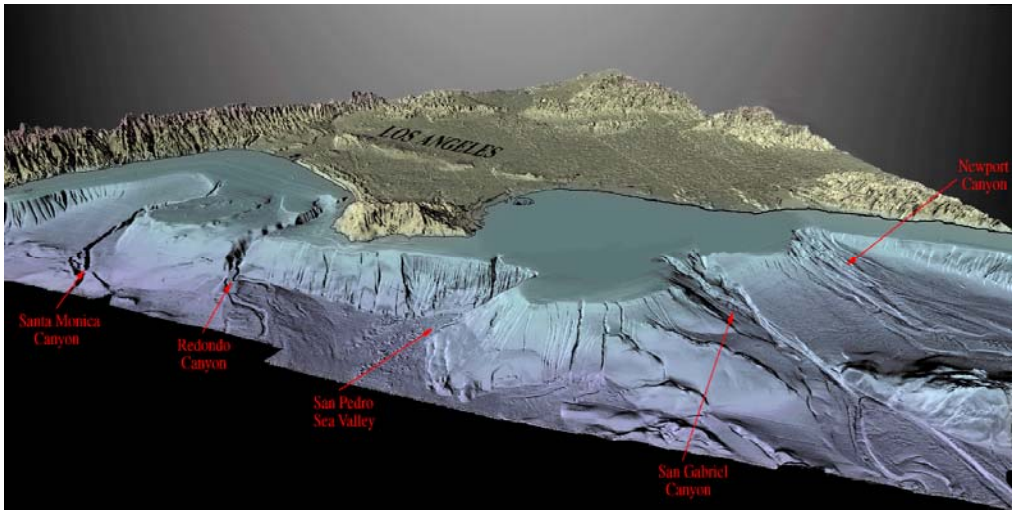

Figure 2. Map of offshore southern California based on modern multibeam sonar data

Current state of offshore mapping:

The critical importance of ocean mapping to the well-being of our nation is exemplified by the fact that at least 15 federal agencies are, in one way or another, involved in coastal and ocean mapping activities – often with responsibilities shared amongst multiple divisions of the same agency. Additionally, a plethora of state and local agencies, academic institutions, the private sector, and other organizations are also involved in offshore mapping. The result has been an inefficient and often chaotic collection of potentially overlapping, and often uncoordinated offshore mapping datasets and products that have been wasteful of resources and frustrating to users.

During our deliberations the NRC committee heard anecdotal evidence that one area in the Gulf of Mexico had been surveyed six or seven times by different groups, most without the knowledge that others had collected similar data. We heard of a state agency that had hired an aircraft to map its coastal region using bathymetric LIDAR – an airborne laser system that can measure shallow depths in clear water. During its survey, the state-hired aircraft had to avoid another aircraft that was using similar equipment to map the same coastal area on a federally funded mission. Just a few weeks ago, during a visit to our lab of one of our industrial collaborators, I happened to learn that they had

recently completed a NOAA-funded survey of an area that the Office of Naval Research was planning to map. We cannot afford this sort of redundant effort.

The way ahead – better management of scarce mapping resources:

The NRC committee gathered information and perspectives from agencies and individuals involved in numerous aspects of offshore mapping and despite the complexity of the issues, the consistency of the concerns that were raised permitted the committee to quickly converge on a vision for the way ahead. This vision called for development of an integrated and coordinated mapping strategy for the nation, based on a foundation – a common spatial reference frame – upon which all data collection, analyses, and products could be based. To establish this foundation, there must be a national effort to collect the information and develop the tools necessary to seamlessly blend topographic (onshore) and bathymetric (offshore) data. These data and tools will permit the establishment of a nationally coordinated digital database across the land/sea interface. This database will consist of seamless elevation and depth data that can be referred or transformed to a common vertical and horizontal reference plane (datum). It will provide the basic geospatial framework for all subsequent offshore data products, much like the USGS topographic sheets have formed the onshore foundation for a multitude of subsequent studies. Unlike the USGS topographic sheets, however, a coastal zone database must be 'tide-aware' and be able to reconcile the differences between onshore and offshore datums.

Our vision for the future of offshore mapping and charting also included mechanisms to ensure communication among all the agencies and entities involved, so as to minimize redundancy of efforts and maximize operational efficiencies. We called for national, and perhaps international, standards and protocols for data collection and metadata creation. Ultimately, the user community should be able to evaluate the accuracy and timeliness of data, change scales and projections, as well as seamlessly merge disparate datasets (that may extend across the shoreline). The database and data integration tools should be easily accessible to all users, public and private, from a single digital portal accessible through the internet.

This was a bold vision, but at the same time an obvious one. Who would argue with a system that was efficient and that produced easily accessible, fully interchangeable, accurate, and timely data? It is a vision that has also been endorsed by the U.S. Commission on Ocean Policy whose Recommendation 25-5 states that:

> "The National Ocean Council (NOC) should coordinate federal resource assessment, mapping, and charting activities with the goal of creating standardized, easily accessible national maps that incorporate living and nonliving marine resource data along with bathymetry, topography, and other natural features."

While the vision may be simple to define, its implementation will be difficult.

H.R. 2400:

H.R. 2400 goes a long way toward establishing an infrastructure that will help integrate and coordinate activities and ensure common data standards. However, our NRC committee made a simple recommendation that we believed could, for a very small investment, produce a tremendous gain in efficiency and prevent redundant mapping efforts. This recommendation called for a web-accessible "national registry" of all past, current, and future, federally-funded offshore mapping activities. Each entry in the registry should include a description of the mapping activity, its location and purpose, the agency collecting the data, the tools to be used, the scales at which data will be collected, and other relevant details. Non-federally-funded agencies conducting coastal mapping activities should be encouraged to register their activities at the same site. A section of the registry should be dedicated to descriptions of planned but unfunded coastal mapping activities, as well as to a "wish list" of coastal areas where surveying would be particularly helpful to state or local agencies. Technically, components of such registration may already be required under Office of Management and Budget (OMB) Exhibit 300, but this recommendation suggests a considerably expanded effort focused on making the scope and details of all federally-funded offshore mapping efforts more widely known.

Once implemented, such a registry would serve as the focal point for national coordination of geospatial data collection and analysis efforts. Individual agencies would continue to set their own priorities but, through the registry process, overlapping efforts would be quickly identified and avoided. The registry would also facilitate increased efficiency by highlighting opportunities for 'incremental' surveys, where one agency takes advantage of the mapping activities of another agency in a region of common interest by providing a small amount of additional funding to achieve an additional objective. Such 'piggy-back' efforts would allow additional agencies to acquire data to meet their needs at minimal incremental cost.

Another important point made by the NRC report is that standard mapping and charting protocols prevent the production of accurate maps and charts that extend across the land/water interface. Differences between agency missions, onshore topographic versus offshore bathymetric mapping techniques, differing vertical reference frames, and the inherent difficulty in collecting data in the surf and intertidal zones have combined to produce this fundamental incompatibility. It will be nearly impossible to properly understand processes that have immense societal effects -- like coastal flooding and inundation – or adequately manage and protect the coastal zone, while two sets of disparate and non-convergent onshore maps and offshore charts are being separately maintained.

The barrier to the production of continuous, integrated mapping products across the land/sea interface is the inherent difference in the horizontal and vertical reference surfaces (datums) and projections used for maps and charts. Horizontal datum and projection issues can be readily resolved with existing transformation tools, although these tools must be made more readily available to the user community. However, vertical datum issues present a serious challenge. In order to seamlessly combine offshore

and onshore data, vertical datum transformation models must be developed. These models depend on the establishment and maintenance of a series of real-time tidal measuring stations, the development of hydrodynamic models for coastal areas around the nation, and the development of protocols and tools for merging bathymetric and topographic datasets.

The Tampa Bay Bathy/Topo/Shoreline Demonstration Project, a collaborative effort between NOAA and the USGS, has developed a suite of such tools (called Vdatum) and has demonstrated the feasibility of generating a seamless bathymetric/topographic dataset for the Tampa Bay area. This project has also demonstrated both the inherent complexity of such an undertaking as well as the substantial benefits that arise from interagency collaboration and coordination. In order to combine onshore and offshore data in a seamless geodetic framework, a national project to apply Vdatum tools should be initiated. This will involve the collection of real-time tide data and the development of more sophisticated but relatively inexpensive hydrodynamic models for the entire U.S. coastline, as well as the establishment of protocols and tools for merging bathymetric and topographic datasets. In outlining a program to integrate and coordinate coastal and ocean mapping activities, H.R. 2400, should also consider the need to seamlessly integrate offshore and onshore data.

Let me conclude my remarks by offering some personal observations. I am delighted to see that H.R. 2400 has incorporated many of the recommendations made by the NRC committee and takes important steps towards making the vision outlined by the NRC committee a reality. In a broader sense, the incorporation of our recommendations into prospective legislation will serve as an inspiration to the scientists and engineers who spend countless hours of voluntary service on National Academy panels, as it demonstrates that their efforts are not in vain and that we have a system that is willing to listen and act. I want to thank you for introducing H.R. 2400. It is an excellent first step towards ensuring that we use our fiscal resources wisely to best manage and protect our precious ocean resources. I thank you for inviting me to testify and will be delighted to answer any questions you may have.