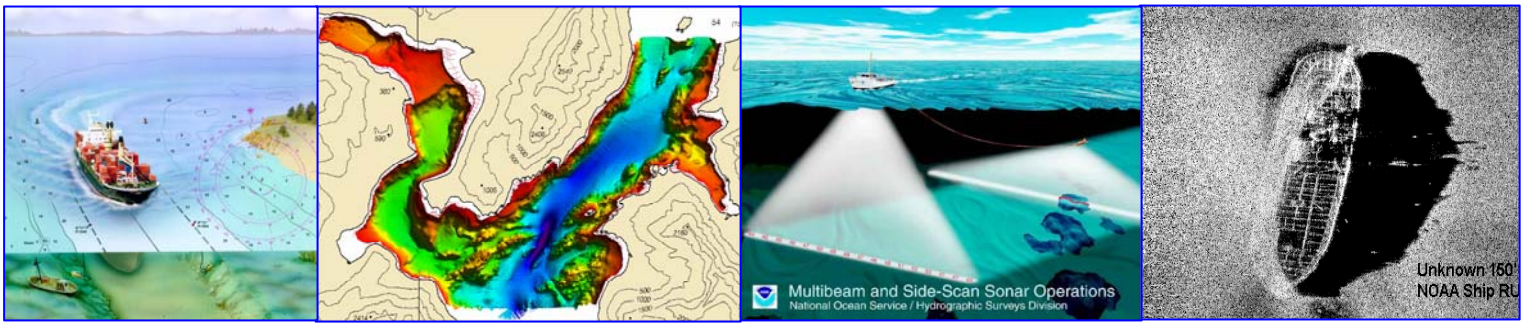
Office of Coast Survey

NOAA Hydrographic Survey Priorities
2007 Edition



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NOAA Hydrographic Survey Priorities

2007 Edition

Part 1

Introduction and Explanation

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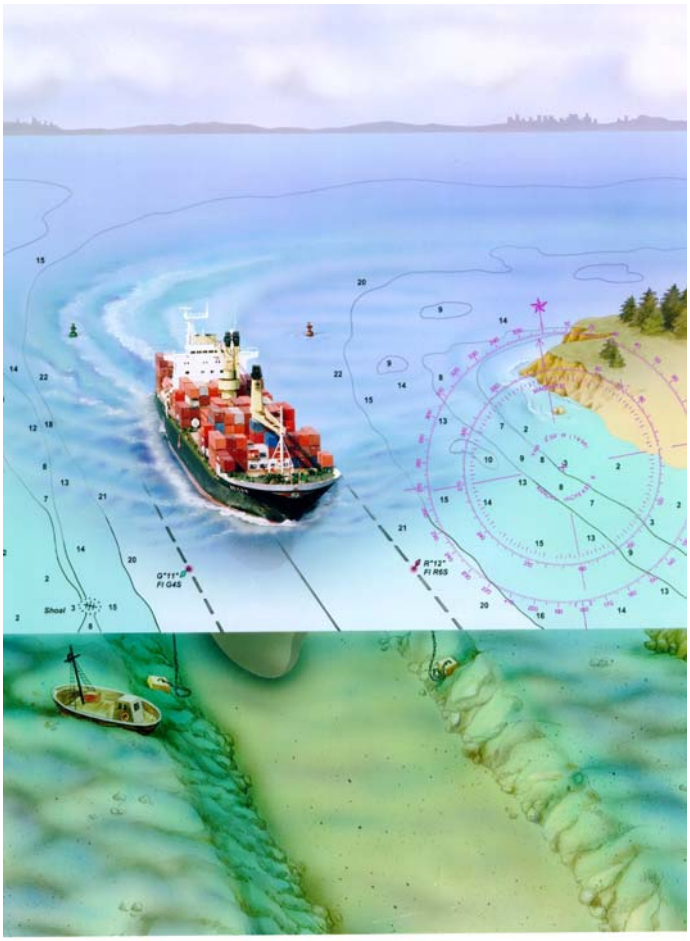
Introduction

The statutory mandate of the National Oceanic and Atmospheric Administration (NOAA) authorizes NOAA to provide nautical charts and related hydrographic information for the safe navigation of maritime commerce as well as provide basic data for engineering, scientific and other commercial and industrial activities. This mandate covers all U.S. territorial waters and the U.S. Exclusive Economic Zone (EEZ), a combined area of 3.4 million square nautical miles (SNM) which extends 200 nautical miles offshore from the nation's coastline. The production of high-quality navigation charts to support the safety of marine transportation depends on the availability of up-to-date, reliable hydrographic survey data.

Safe and efficient movement of goods through U.S. ports is vital to maintaining a competitive standing in the global economy. The United States is the world's largest trading nation, importing and exporting a quarter of the world's merchandise trade (~$2 trillion)[1]; a vast majority of it is transported by sea. Additionally, over 4,400 cruise ships, carrying 9.7 million passengers, departed U.S. ports in 2005[2]. Maritime commerce has escalated since the 1950s and is conservatively projected to grow by 50% within the next 20 years[3]. This increase in commerce will result in the continual expansion of the frequency, length, width, and draft of ships carrying passengers or cargo; 1100-foot long, 130-foot wide, 60-foot draft vessels are not uncommon on our nation's waterways. Environmental damage caused by vessel groundings and collisions at sea is also cause for increasing concern.



The nation's reliance on safe, efficient, and environmentally sound marine transportation emphasizes the critical need for NOAA to maintain high-accuracy nautical charts and supporting products.

In addition to commercial marine traffic, recreational boating is a major part of the nation's economy that relies on up-to-date nautical charts and supporting hydrographic survey data. A $30 billion industry, there are over 13 million registered boats in the U.S., and over 8,000 recreational marine facilities[4]. Although primarily focused on addressing the backlog of critical hydrographic survey needs in commercial shipping areas, NOAA also recognizes the importance of supporting the navigation safety requirements of recreational boaters on the nation's waterways and will address them as available resources allow.

NOAA developed the "National Survey Plan" (NSP) in November 2000, to identify and prioritize the areas within NOAA's scope of navigation safety responsibilities that are in greatest need of hydrographic surveys, thereby ensuring the most efficient use of taxpayer-provided resources. The name of the document was changed in 2004 to the "NOAA Hydrographic Survey Priorities" (NHSP), to more accurately describe the intent of the document as a consolidated snap shot of generalized area outlines depicting the current hydrographic needs of the nation. The prioritization of the nation's survey requirements needs to be revised periodically due to the dynamic nature of the trends in waterborne commerce, the increasing size and draft of commercial vessels, sea-floor changes due to natural and man-made processes, and the need for more highly detailed hydrographic survey coverage utilizing modern technologies. NOAA will review the priority assignments in the NHSP and publish new editions to the website yearly.

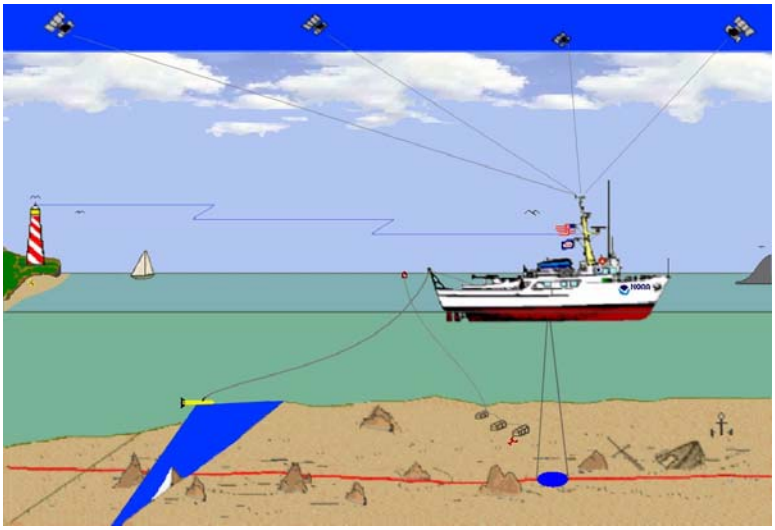
The 2007 edition of the NOAA Hydrographic Survey Priorities can be viewed on the world wide web at http://nauticalcharts.noaa.gov/

The 2007 Edition

The 2007 edition reflects all the surveys completed through the 2006 calendar year. An additional 1,464 SNM of critical area has been completed since the 2006 edition of the NHSP. Of the established 43,000 SNM of critical area approximately 21,660 SNM remains to be surveyed.

Notable modifications in this version include:

- Adding Lake Pontchartrain in Louisiana to navigationally significant area as priority 2.
- Multibeam surveys not conducted by OCS but were processed and incorporated into charting program have been added to the "Full Bottom Coverage Era" layer.



Limitations of the Area Delineations and Mileage Calculations in the NHSP

It is important to note that the graphics and SNM area calculations in the NHSP are estimates based on generalized layouts and are subject to imprecision of +/-10% or more. When a survey is conducted, the resulting data submitted for charting are typically represented at a scale ranging from 1:10,000 to 1:40,000. This is up to two-hundred times more detail than represented in the NHSP GIS files. Representation of the vast area under NOAA's mandated responsibility for hydrographic survey requires generalization, and must allow for imprecision in calculating area between the planned areas and what is actually accomplished in the field. The intent of the NHSP is to provide a concise reference to communicate the vast hydrographic survey needs of the nation, and provide a base prioritization reference for conducting more detailed planning of survey projects.

Critical Need for Modern Surveys

To meet its charting mandate, NOAA maintains a suite of approximately 1,000 nautical charts that cover the EEZ. Many areas portrayed on nautical charts have never been adequately surveyed because of the limitations of historical technology. Nearly half of the soundings published on current charts were acquired using lead line techniques before 1940. Additionally, discrete point sounding distributions on smooth sheets can exceed 500 meters in distance, potentially missing crucial shoals or other navigationally significant features, and may not reflect actual water depths.

Historic surveys prove insufficient on modern charts for many reasons. Present sounding inventories represent a partial description of the seafloor. Widely spaced survey lines may not contain enough soundings to detect rocks and obstructions that protrude above the sea bottom. Many navigation areas are dynamic; shifting shoals, wrecks, and changing shorelines are hazards that warrant routine measurement. Historical sounding positions are less accurate than positioning available to modern vessels using the Global Positioning System (GPS) and Electronic Chart Display and Information Systems

(ECDIS). Navigators may not understand these and other accuracy limitations of data from historical surveys, and may inadvertently place their vessels at risk.

Hydrographic Surveying

Data collection and compilation for nautical charts are the principle objectives of a hydrographic survey. Hydrographic survey data support a variety of maritime functions including safe navigation, port and harbor maintenance (dredging), coastal engineering (beach erosion and replenishment studies), coastal zone management, and offshore resource development. The primary data associated with hydrographic surveys are water depth (bathymetry) and object detection. However, there is also considerable interest in sea-floor texture and composition (i.e., sand, mud, rocks) due to their implications for anchoring, dredging, marine construction, pipeline and cable routing, tsunamis, and storm surge modeling. The bathymetric, backscatter, and side scan sonar data can also be used to support other NOAA missions such as fish habitat characterization, bottom type classification, and submerged cultural resources management.

Data acquisition for nautical chart updates begins with the selection of a survey area and deployment of resources to accurately and efficiently conduct the survey. Following extensive planning, NOAA or contractor field units conduct hydrographic survey operations. Survey teams calibrate all sonar and vessel orientation and positioning systems prior to data acquisition to assure proper equipment operation. Data accuracy must comply with predetermined specifications, and each individual depth measurement corrected for velocity of sound through the water column, vessel heave, pitch, and roll, vessel configuration offsets, water level, and other factors in effect at the time each measurement was acquired. Field units conduct frequent conductivity, temperature, and depth measurements to ensure proper sound velocity corrections are applied to sounding data. Water level stations are installed to monitor water level variations in the survey area to provide corrections to reduce data to the proper tidal datum. NOAA Center for Operational Oceanographic Products and Services (CO-OPS) receives water level information via geostationary satellites and continuously monitors transmissions to detect instrument malfunctions.

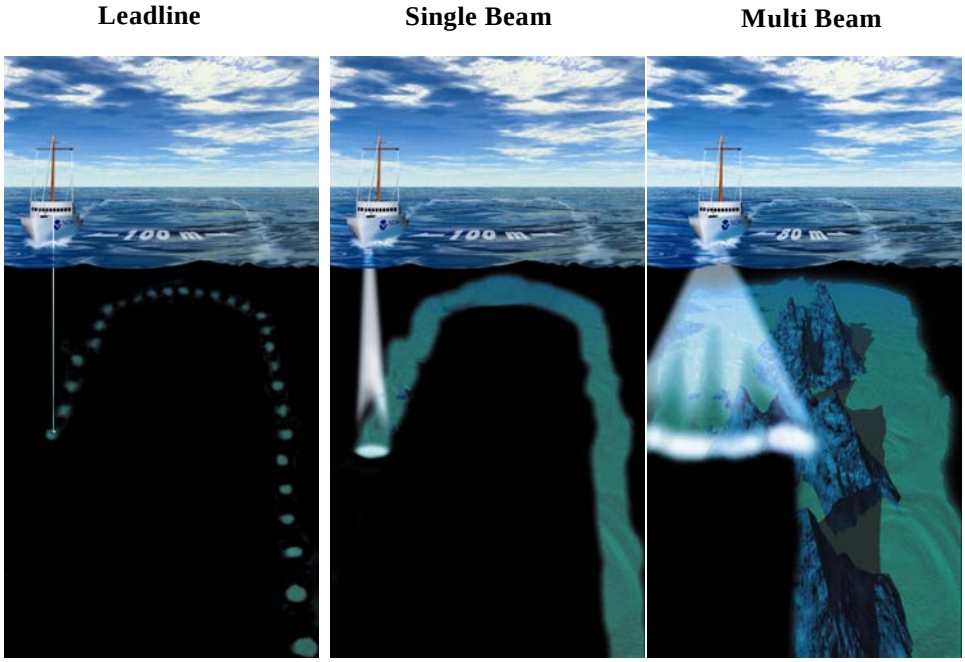
GPS satellite systems provide precise positioning for survey data and additional accuracy is determined using the U.S. Coast Guard Differential GPS (DGPS) network. Fixed land stations monitor variations in GPS satellite signals and transmit correctors to survey platforms during data acquisition. DGPS broadcast sites provide correctors for most survey areas, but remote areas, such as some areas in Alaska, require the placement and maintenance of independent DGPS ground reference stations.

Primary depth measurements are acquired with multibeam sonar, or with a single beam echosounder if multibeam is not available. Multibeam technology obtains hundreds more soundings per unit time than single beam systems and covers a wide swath of the ocean floor. Some field units employ side scan sonar (SSS) systems, which use a towed instrument to assist in detecting objects (wrecks, rocks, or other obstructions) that project

from the sea floor. As potential hazards to navigation, these objects must be fully investigated and verified by multibeam sonar or divers. Side scan and multibeam sonar are modern systems which provide near 100% bottom coverage of the sea floor, greatly enhancing the ability to detect hazards undiscovered by earlier, less modern surveys.

NOAA also uses Light Detection and Ranging (LIDAR) technology to collect hydrographic data in near shore areas where conditions are suitable. This makes launch operations in these areas more efficient by allowing the vessels to spend less time in the more shallow regions where the sonar swath widths make them less efficient. LIDAR, however, does not provide the object detection capabilities of multibeam, therefore some follow-up multibeam work is generally required in irregular sea-floor areas initially surveyed with LIDAR to resolve ambiguities in the LIDAR data and to perform least depth measurements on significant obstructions.

Bottom Coverage Comparison by Survey Method



Sonar or LIDAR data acquisition produces millions of measurements, which need to be verified and compiled to produce an accurate, understandable graphic depiction of the survey area. A digital version of the survey and/or a hard copy Smooth Sheet are produced for final quality assurance, nautical chart compilation, and archiving. A descriptive report accompanies each survey and provides detailed descriptions of items that cannot be explained in graphic form.

A hydrographic survey incorporates other measurements or observations. These include precise positioning of aids to navigation, conspicuous landmarks, and offshore drilling structures, and sampling of the sea floor bottom material to determine adequate anchorage areas. Also documented are the variations in the shoreline location or features along the shore (new piers, pilings, bulkheads).

Prioritizing Survey Needs

NOAA must prioritize areas in need of surveying in order to maximize the efficiency of the limited resources available for conducting hydrographic surveys. To accomplish this, the 3.4 million square nautical miles of the EEZ were examined first for navigational significance based on depth of water, draft of ships utilizing the regions, and potential for pinnacle rocks or other dangers to marine navigation due to irregular seafloor topography. As a result, approximately 500,000 square nautical miles of the EEZ was determined to be Navigationally Significant. The Navigationally Significant areas were then prioritized by researching shipping tonnage and trends, vintage of surveys in the area (year, equipment, and processes utilized), under-keel clearance of vessels, potential for unknown dangers to navigation due to dynamic bottom or human influence, and requests for surveys from Pilot Associations, the U.S. Coast Guard, and the marine community through NOAA's Regional Navigation Managers.

Navigationally Significant

Navigationally significant areas are defined using different criteria due to varying characteristics of the sea floor. For instance, the offshore limit of the navigationally significant area of southern Alaska and the Pacific Islands is defined to be 100 fathoms, because of the rugged nature of the bottom. From shore, depths increase rapidly, but offshore rocky pinnacles rise from great depths to create potential hazards to navigation. Along the East and West Coasts, where this type of bottom configuration is much less likely to occur, a 20-fathom off-shore limit is adequate to protect against likely natural hazards.

The off-shore depth limits of navigationally significant areas are defined as:

- 20 fathoms (120 feet) along the Atlantic and Pacific coasts,
- 20 fathoms (120 feet) in the eastern Gulf of Mexico,
- 50 fathoms (300 feet) in the western Gulf of Mexico,
- 100 fathoms (600 feet) in southern Alaska (Gulf of Alaska)
- 50 fathoms (300 feet) in western Alaska (Bering Sea)
- 20 fathoms (120 feet) along the north slope of Alaska,
- 20 fathoms (120 feet) in the Caribbean around Puerto Rico and Virgin Islands
- 100 fathoms (600 feet) in the Pacific Islands.

The fjords and sounds of the Pacific Northwest and Alaska pose one exception to the depth limit. In these narrow waterways, the navigationally significant area extends from shoreline to shoreline, regardless of depth, in order to avoid a narrow strip of unprioritized (and unsurveyed) area down the center of the fjord. In addition, in the Great Lakes, the navigationally significant area also extends from shoreline to shoreline or from shore to the U.S./Canada maritime border.

Critical Areas

Navigationally significant areas are then subdivided based on the need for hydrographic surveys. The highest priority areas are called critical areas. Critical survey areas are defined as waterways with high commercial traffic volumes (cargo, fishing vessels, cruise ships, ferries, etc.), extensive petroleum or hazardous material transport, compelling requests from users, and/or transiting vessels with low under-keel clearance over the seafloor.

In 1994, NOAA identified approximately 43,000 square nautical miles, primarily coastal shipping lanes and approaches to major U.S. ports, as critical areas. These critical areas have also been referred to as the critical survey backlog. The critical survey area:

< Encompasses less than 1.5% of the entire U.S. EEZ;
< Represents only 9% of the navigationally significant areas; and,
< Over 40% of all critical survey areas are in Alaskan waters.

The critical and other priority areas were revised in 2004 to provide a more accurate and up-to-date representation of the nation's hydrographic survey requirements. A category titled "emerging critical area" was created in 2004 to allow for designation of areas that now meet the definition of critical area, but can be tracked separately from the 43,000 SNM estimate established in 1994. The emerging critical areas delineated are primarily located in the Gulf of Mexico (GOM) and in Alaskan waters surrounding Kodiak Island. The vintage of hydrography in portions of the GOM are from the 1800s when lead line technology was used. Many of these areas have become major hubs for deeper draft commercial traffic in recent years due to growth in the petroleum industry. Some charted areas have reported discrepancies of tens of feet from actual depths. Kodiak, Alaska, is another area with expansive areas of 1800's vintage or no survey coverage at all. The area has seen an increase in commercial fishing and eco-tour traffic that hug the coastline, and has been subjected to significant tectonic forces which have altered the seafloor since earlier surveys.

NOAA intends to review and update the classification of areas in the NHSP on a periodic basis.

Emerging Critical

A new category, named emerging critical area, was created for the 2004 edition to allow for designation of additional areas that now meet the definition of critical area, but were not included in previous editions of the NHSP. These areas have the same compelling need for survey as the critical area backlog, but can be tracked separately from the 43,000 SNM estimate established in 1994.

Resurvey Areas

The examination of an area with modern survey methods does not preclude the need for subsequent surveys. Some areas require periodic survey due to naturally occurring changes (e.g., silting, shoal migration, earthquakes), use by increased size vessels, or other changes in the navigational use of the area. Because most resurvey requirements are driven by natural changes to the seafloor, the time frame for resurveying varies by area. For example, Fire Island Shoal in Anchorage, Alaska, should be resurveyed every 2 to 3 years, while portions of the approaches to Chesapeake Bay and Delaware Bay should be resurveyed every 5 to 7 years. The resurvey area delineations are more generalized than the critical and priority area delineations. Over 9,200 square nautical miles have been defined as resurvey areas.

Priority 1 – 5 Areas

The remaining navigationally significant areas have been subdivided into five priority levels, based on the age of the prior surveys in those areas and, to a lesser extent, vessel usage. The age of the survey is classified into three technological eras: pre-1940 surveys consisting of lead line soundings and sextant positioning; 1940 to 1970 surveys consisting of single beam echo sounders and improved positioning methods (including some electronic positioning); and 1970 – 1993 surveys consisting of modern automated survey technologies, electronic positioning and, in later years, DGPS positioning. A new category which depicts areas surveyed since 1994 has been added to this edition to reflect accomplishment of survey areas with modern technology.

Since 1994, the U.S. Coast Guard, marine pilots, and port authorities have identified numerous additional areas as critical to safe navigation and in need of new hydrographic surveys. These are due in some cases to geologic changes and in others to changes in vessel usage. For example: 1) sedimentation occurs near river mouths and many Alaskan glaciers have retreated miles inland, exposing uncharted sea bottom and potential navigation hazards to the increasing number of passenger ships cruising ever closer to glaciers; and 2) traffic patterns in some ports have been altered due to the increasing size of commercial vessels, new pier construction, sedimentation, and dredging.

<u>Priority One</u>
Assigned to navigationally significant areas that have pre-1940 surveys and annual:

- petroleum transports over 1,000,000 tons; or
- coal transports over 600,000; or
- chemical transport over 100,000 tons; or
- cargo traffic over 5,000,000 tons; or
- passenger transport over 10,000 persons.

Priority One classification was also assigned to some areas not classified as critical, but containing charted safety fairways, anchorages, increasing traffic volume, or a potential for previously undetected or recently created man-made or natural obstructions

Approximately 49,000 SNM are defined as Priority One.

Priority Two
Assigned to navigationally significant areas that have pre-1940 surveys, but no specified traffic level.

Approximately 118,000 SNM are defined as Priority Two.

Priority Three
Assigned to navigationally significant areas that have pre-1970 surveys that have not been categorized previously as Priority One or Two.

Approximately 100,000 SNM are defined as Priority Three.

Priority Four
Assigned to those areas with surveys completed between 1970 and 1994 that have not been defined as a critical area. Surveys conducted between 1970 and 1994 utilized electronic navigation and digital data acquisition and processing systems. However, these surveys were not necessarily performed with the near full bottom coverage technology used today.

Approximately 60,000 SNM are defined as Priority Four.

Priority Five
Assigned to areas in the Gulf of Mexico and Alaska regions that are of greater depth, 20-50 fathoms in the Gulf of Mexico, 50-100 fathoms in Alaska, which have unsurveyed areas or pre-1940 prior surveys. Although less risk to navigation due to the deeper waters, these areas need to be addressed because there is still a potential for obstructions or highly irregular sea-floor topography.

Approximately 132,000 SNM are defined as Priority Five.

Completed Surveys – "Full Bottom Coverage Era" Category

Areas surveyed since the beginning of 1994 are being classified as "Full Bottom Coverage Era" surveys, and are represented on the prioritization graphics. This era reflects the common use modern Side Scan Sonar, Multibeam and LIDAR technologies that provide a wide along track ensonification of the bottom. These technologies greatly reduce the possibility of a field unit not detecting a dangerous feature on the bottom compared to limitations of earlier generation technology that utilized point or line-sampling rather than full coverage technology and processes. Surveys in this category however, do not all meet object detection standards, which is the ability to detect small features on or extending from the sea floor. Some areas surveyed during this era may need periodic resurvey due to the high potential for changes in the seafloor due to natural

or man-made factors. As of the date of this edition, approximatly 23,000 SNM of navigationally significant area has been surveyed during the full bottom coverage era. Completed surveys will continue to be added to this classification each year into the future.

Square Nautical Mile Breakout of NHSP Priority Categories

The table below shows the estimated mileage breakout, in square nautical miles, of each NHSP category. These figures were calculated utilizing GIS tools, and are subject to imprecision due to the generalized nature of the priority and historical survey area delineations, and the represented scale of the NHSP.

Square Nautical Mile Breakout* of NHSP Priority Categories**

	Navig. Significant	Critical	Emerging Critical	Priority 1 Areas	Priority 2 Areas	Priority 3 Areas	Priority 4 Areas	Priority 5 Areas	Completed (post-1993 survey)
East Coast	**53,390**	**4,421**	**0**	**7,254**	**5,843**	**15,775**	**14,639**	**0**	**5,458**
Gulf of Mexico	**73,494**	**9,648**	**2,440**	**11,565**	**8,078**	**14,750**	**8,788**	**14,501**	**3,724**
West Coast	**5,309**	**334**	**37**	**116**	**2,429**	**991**	**801**	**0**	**601**
Alaska	**324,478**	**6,985**	**3,707**	**25,161**	**94,417**	**34,663**	**29,034**	**117,795**	**12,716**
Great Lakes	**46,125**	**224**	**0**	**4,915**	**3,002**	**32,620**	**5,353**	**0**	**11**
Hawaii and Pacific Is.	**6,616**	**25**	**0**	**1**	**4,287**	**962**	**647**	**0**	**694**
Caribbean Islands	**1,533**	**24**	**0**	**40**	**207**	**341**	**630**	**0**	**291**
Total	**510,945**	**21,661**	**6,184**	**49,052**	**118,263**	**100,102**	**59,892**	**132,296**	**23,495**

***Calculations derived from generalized area delineations; estimated accuracy is +/- 10%**
****There are approximately 9,200 SNM of resurvey area for the U.S.**

Annual Survey Planning

The NHSP is the base reference for long term scheduling of hydrographic survey projects. For more short term scheduling, the critical and priority areas are matched against urgent needs (recent groundings, accidents, etc.), compelling requests from the user community, traffic volume, and greatest potential for dangers to navigation. Other factors such as seasonal weather conditions, platform mobilization and transit costs, logical project succession, and opportunity for multipurpose projects are taken into account when developing annual survey plans to enable safe and efficient use of expensive platform time. Large scale regional plans are scheduled several years in advance to allow NOAA programs supporting hydrographic surveys to provide detailed shoreline data from remote sensing sources, and tide zoning and gauge requirements for water level corrections. The NOAA Hydrographic Surveys Division must also perform a

detailed pre-survey review of charted features and other potential dangers reported by the user community into the Automated Wreck and Obstruction Identification System (AWOIS) data base. The annual survey plan is finalized at least six months before the beginning of the survey "field season" which begins in early March.

NOAA strives to address critical areas first, and will survey priority and resurvey areas in conjunction with critical area to enable the most efficient use of survey platforms. Priority areas will also be scheduled in lieu of critical areas when seasonal weather factors prevent safe and efficient operations in challenging environments such as the Southwest Alaska Peninsula. In these areas NOAA concentrates in-house and private sector assets during the favorable weather months.

How to Submit Hydrographic Survey Needs to NOAA

It is important to note that this document is dynamic and will evolve over time. The graphics shown are a snapshot of the current priorities. The areas and associated square mileage calculations will be revised as surveys are completed and as shipping conditions change. For example, a port that is not defined today as critical may attain critical status if shipping levels increase or a new oil or Liquefied Natural Gas (LNG) terminal is built. Conversely, an area defined as critical today may drop to a lower priority if shipping levels decrease or a terminal closes.

The marine community is encouraged to submit information to NOAA to assist in prioritizing the Nation's hydrographic survey needs. Information and requests for hydrographic surveys or other NOAA navigation products and services should be submitted through NOAA's regional Navigation Managers. A listing of the Navigation Managers and their contact information is provided in Appendix II. Please submit any comments or questions regarding the NOAA Hydrographic Survey Priorities document to the Chief, Hydrographic Surveys Division, at http://ocsdata.ncd.noaa.gov/dr/inquiry.asp.

The NHSP can be viewed on-line at http://nauticalcharts.noaa.gov/

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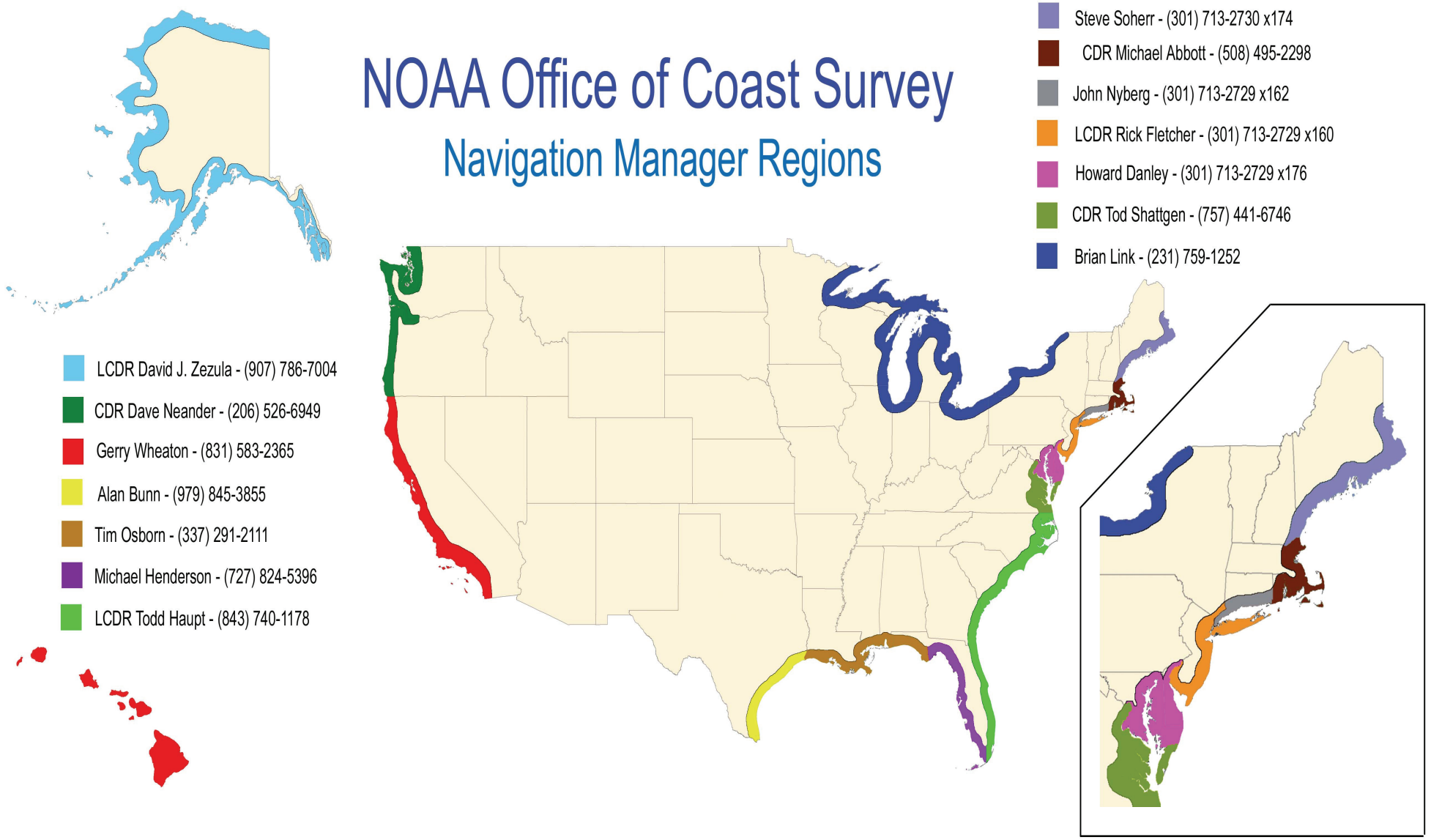
Navigation Manager Regions



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