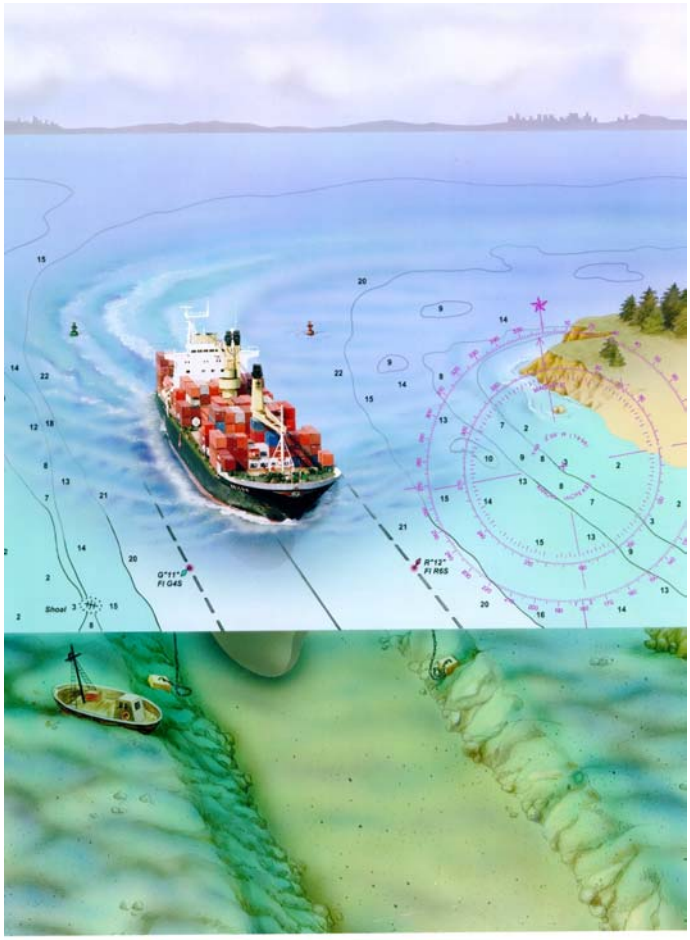
NOAA Hydrographic Survey Priorities
March, 2004 revision (DRAFT)

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.

Maritime commerce has escalated since the 1950s and is conservatively projected to double within the next 20 years. This increase in commerce will result from an expansion of the length, width, and draft of ships carrying cargo; 1000-foot long, 120-foot wide, 50-foot draft vessels are not uncommon on our Nation's waterways. Today, more than 95% of U.S. foreign trade by weight (two billion tons) travels by sea. Approximately one half of this cargo is petroleum or hazardous materials. **Safe and efficient movement of goods through U.S. ports is vital to maintaining a competitive standing in global economics.** Additionally, environmental damage caused by vessel groundings and collisions at sea is cause for increasing concern. These trends emphasize the critical need for high-accuracy nautical charts to support a safe and profitable waterways system. The production of high-quality charts depends on the availability of up-to-date, reliable hydrographic survey data.



NOAA developed the "National Survey Plan" (NSP) in November 2000, to address current trends in maritime navigation and support NOAA Navigation Services and interagency Marine Transportation System (MTS) programs. The name has been changed to "NOAA Hydrographic Survey Priorities" (NHSP) for the 2004 revision; 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 survey requirements needs periodic revision due to the dynamic nature of waterborne commerce trends, 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 anticipates publishing new editions of this document every three years.

The 2004 revision provides greater detail in the delineation of critical and priority areas, and incorporates improvements in Geographic Information System (GIS) technology to facilitate improved planning and accomplishment tracking functions. The existing area outlines have been refined to conform to a more detailed shoreline, and to remove broad generalizations and misalignments. The GIS tables have been attributed to allow for quick reference to comments supporting area designations and changes in priority. The areas have also been revised to better reflect the nation's current hydrographic survey needs, which are determined through input from various marine authorities, NOAA's regional navigation managers, U.S. Army Corps of Engineers waterborne commerce statistics, and other data sources.

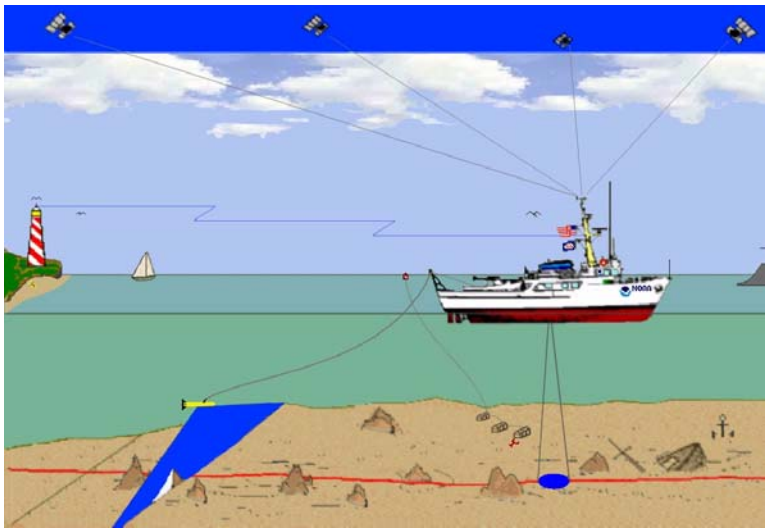
The 26,600 snm of critical area defined in this edition are considered a stable baseline for tracking purposes, and is reflective of survey completion since1994 when 43,000 snm of critical area were estimated to exist. A new category, named "Emerging Critical Area," has been created in the 2004 edition to allow for designation of additional areas that now meet the definition of "Critical Area," but were not included in previous versions of the NSP. These areas have the same compelling need for survey as the "critical backlog," but can be tracked separately from the 43,000 snm estimate established in 1994. A table summarizing the survey completion and scope of revisions to the critical area between the 1994 and 2004 editions is included in Appendix 1.

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 1000 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 measured using lead line techniques before 1940. Additionally, discrete point sounding distributions on published charts can exceed 500 meters, 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 portray rocks and obstructions that protrude above the sea bottom. Many navigation areas are dynamic; shoals, wrecks, and changing shorelines are hazards that warrant routine measurement. Historic 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 historic surveys, and may inadvertently place their vessels at risk.



Hydrographic Surveying

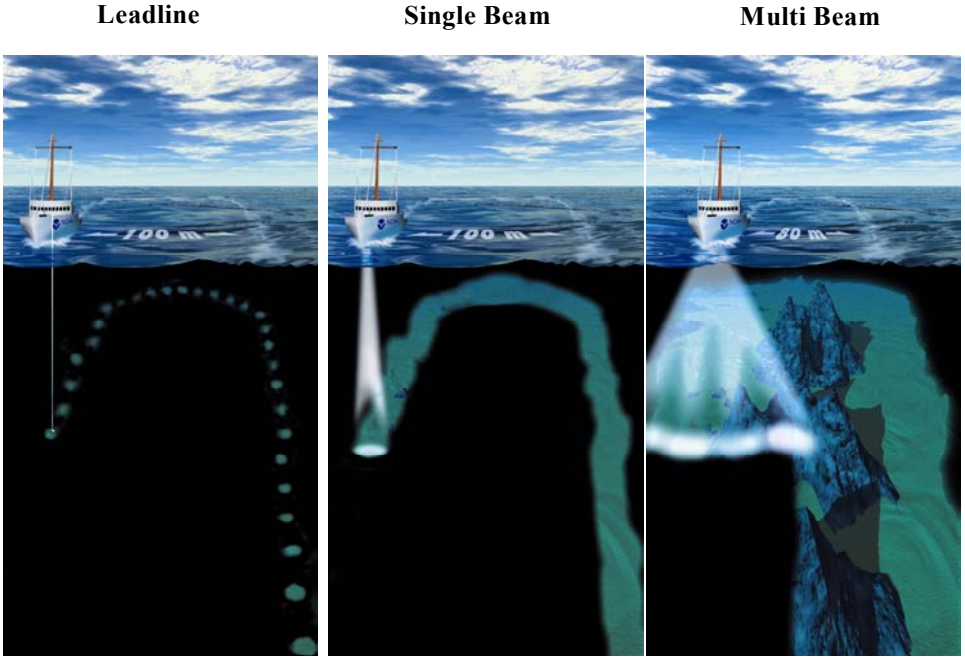
Data collection and compilation for nautical charts are the principle objectives of a hydrographic survey. Hydrographic survey data support a variety of maritime functions including safe navigation, port and harbor maintenance (dredging), coastal engineering (beach erosion and replenishment studies), 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, storm surge modeling, and fisheries habitat characterization.

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 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, state of tide, and other factors in effect at the time each measurement was acquired. Field units install tide gauges to monitor water level variations in the survey area to provide the tidal corrections. NOAA Center for Operational Oceanographic Products and Services (CO-OPS) receives tide gauge 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 Alaska, require the placement and maintenance of independent DGPS ground reference stations.

Bottom Coverage Comparison by Survey Method



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 where conditions are favorable.

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 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

Prioritizing survey areas to maximize the efficiency of the limited resources available for conducting hydrographic surveys is essential. To accomplish this, the 3.4 million square nautical miles of the EEZ were examined for navigational significance, giving highest priority to those near shore areas with the greatest threat of natural and manmade hazards to marine navigation. As a result, approximately 500,000 square nautical miles of the EEZ were deemed "navigationally significant."

Navigationally Significant

Navigationally significant areas are defined with 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 offshore 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 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
- In addition, 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" has been created in this edition 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 in this edition of the NHSP are located in the Gulf of Mexico (GOM) or 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. Current charts are inadequate for supporting safe navigation in this region. NOAA intends to review and update the classification of areas on a periodic basis.

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, must 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.

Note: The resurvey area delineations are more generalized than the critical and priority area delineations. The resurvey areas are currently under revision. Most areas identified for periodic resurveying fall within one of the critical survey areas. Over 5,000 square nautical miles have been defined as resurvey areas.

Other Priorities

The remaining navigationally significant areas can be 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 post-1970 surveys consisting of modern automated survey technologies, electronic positioning and, in later years, DGPS positioning and near full-bottom survey coverage.

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.

Priority One

Assigned to navigationally significant areas that have pre-1940 surveys and annual:

- petroleum transports over 1,000,000 tons; 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

Nearly 49,000 square nautical miles are defined as Priority One.

Priority Two

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

Over 126,000 square nautical miles are defined as Priority Two .

Priority Three

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

Nearly 102,000 square nautical miles are defined as Priority Three.

Priority Four

Assigned to those areas with post-1970 prior surveys that have not been defined as a critical area.

Over 75,000 square nautical miles are defined as Priority Four.

Post-1970 surveys were conducted primarily with electronic navigation, digital data acquisition and processing systems. However, these surveys were not necessarily performed with the near full bottom coverage technology used in the field today.

Priority Five

Assigned to areas in the Gulf of Mexico and Alaska regions. These are areas of greater depth, 20-60 fathoms in the Gulf of Mexico, 50-100 fathoms in Alaska, which have unsurveyed areas or pre-1940 prior surveys where there is the potential for obstructions or highly irregular sea-floor topography.

Over 132,000 square nautical miles are defined as Priority Five.

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

Square Nautical Mile Breakout* of NHSP Priority Categories

	Navig. Significant	2004 Critical Areas Remaining	Resurvey Areas	Priority 1 Areas	Priority 2 Areas	Priority 3 Areas	Priority 4 Areas	Priority 5 Areas
East Coast	**53,610**	**5,669**	**1,646**	**6,425**	**6,879**	**16,240**	**18,268**	**0**
Gulf of Mexico	**70,249**	**10,425**	**2,311**	**7,691**	**13,761**	**15,366**	**11,920**	**14,551**
West Coast	**5,158**	**489**	**546**	**13**	**2,538**	**1,162**	**1,108**	**0**
Alaska	**326,561**	**9,713**	**557**	**30,346**	**94,589**	**34,870**	**37,133**	**117,862**
Great Lakes	**46,202**	**228**	**0**	**4,682**	**3,234**	**32,493**	**5,352**	**0**
Hawaii and Pacific Is.	**6,623**	**29**	**0**	**2**	**4,996**	**963**	**649**	**0**
Caribbean Islands	**1,550**	**38**	**0**	**221**	**208**	**417**	**653**	**0**
Total	**509,953**	**26,591**	**5,060**	**49,380**	**126,205**	**101,511**	**75,083**	**132,413**

***Calculations derived from generalized area delineations; estimated accuracy is +/- 10%**

Conclusion

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 NOAA Hydrographic Survey Priorities can be viewed on the world wide web at http://chartmaker.ncd.noaa.gov/staff/NHSP.htm. The areas and associated numbers 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. Similarly, an area defined as critical today may drop to a lower priority if shipping levels decrease or a terminal closes.

Please submit any comments or questions regarding the NOAA Hydrographic Survey Priorities to Chief, Hydrographic Surveys Division, at HSD.Inquiries@NOAA.gov.

The safe maritime transport of people and cargo is vitally important to the economic and environmental health of the nation. The U.S. maintains infrastructure based on modern hydrographic surveys which greatly reduce the risk of undiscovered hazards to navigation. This document identifies and prioritizes the areas in greatest need of hydrographic surveys, thereby ensuring the most efficient use of taxpayer-provided resources.

NOAA Hydrographic Survey Priorities Appendix 1

Summary of completion and revisions to the critical survey backlog: 1994-2003

NHSP Region	*1994 Critical Area - SNM	**SNM Completed 1994-2003	***SNM remaining per 2004 NHSP
East Coast & PR/USVI	4,900	3,500	5700
Gulf of Mexico	14,700	2,500	10,500
Great Lakes	300	0	200
West Coast	1,200	500	500
Hawaii and Pacific Isles	100	0	30
Alaska	21,800	7,600	9,700
Totals	43,000	14,100	26,600

*These values were estimated in 1994 from outlines drawn on paper charts, thus are subject to significant imprecision.

**These calculations were derived from generalized completed survey outlines, some recreated from paper outlines of historical survey coverage and input into a GIS system; more accurate tracking processes have been implemented in 2004. Estimated accuracy is +/- 15% or more.

***These calculations derived using GIS tools, and are subject to imprecision due to the generalized nature of the NHSP priority area delineations and the represented scale of the NHSP. Estimated accuracy is +/- 10%.