

Office of Coast Survey
Navigation Services Division

A Captain of the Port guide to NOAA emergency hydrographic survey

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CONTENTS

About this Guide	2
Purpose.....	2
Companion guide.....	2
Stay updated on Coast Survey activities	2
Questions or comments	2
Executive summary	3
1. The Navigation Services Team	4
Headquarters.....	4
Navigation Managers.....	4
Navigation Response Teams (NRTs)	6
<i>R/V Bay Hydro II</i>	7
Mobile Integrated Survey Team (MIST).....	8
Autonomous systems.....	9
2. What to expect from Coast Survey during a disaster response	10
In the incident command post.....	10
In the field	10
Products.....	10
Survey planning and considerations	11
Survey asset coordination.....	11
3. Field Unit Specifications and Requirements	12
4. NOAA survey methodologies	13
5. NOAA navigation support between incidents	13
Routine operations.....	13
Emergent needs and requests	14
6. Appendix	14
List of Acronyms:	14
The history of the Office of Coast Survey	15
Organizational charts.....	15

About this Guide

Purpose

This guide is created to help the United States Coast Guard (USCG) Captain of the Port (COTP) understand the full scope of support services available to them through NOAA's Office of Coast Survey (OCS).

We know the USCG shares our vision of providing navigation products and services that ensure safe and efficient maritime commerce on America's oceans, coastal waters, and in the Great Lakes. The USCG consistently demonstrates its dedication to protecting lives, property, and the environment during responses to emergency incidents. During emergency responses, OCS works alongside the USCG to reopen in the most efficient manner possible.

To that end, OCS will develop, communicate, and apply practical and credible science in preparing for and responding to risks, and mitigating the consequences from wrecks and other navigation hazards threatening the marine transportation system.

OCS wishes to thank the USCG for making us an integral part of its response efforts.

Companion guide

This guide is formatted to match a Federal On-scene Coordinators (FOSC) guide to NOAA scientific support, created by NOAA's Emergency Response Division. It is anticipated that the guide will assist the USCG FOSCs in understanding the full scope of scientific support services available to them through NOAA when responding to environmental threats.

Stay updated on Coast Survey activities

NOAA's Office of Coast Survey uses social networking platforms to share information with stakeholders and with the public. You can get the latest updates on Coast Survey's work by:

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- Subscribing to our [quarterly newsletter](#)
- Subscribing to [our blog](#)
- Following us on [Facebook](#) and [Twitter](#)

Questions or comments

If you have questions or comments about this guide, contact one of the following individuals:

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Executive summary

This guide is designed to assist USCG Captains of the Port and their team understand, utilize, and cooperate with NOAA's Navigation Services Division during response situations.

Navigation managers are the initial point of contact when requesting NOAA's Office of Coast Survey support. Navigation managers help coordinate LiDAR surveys, tide and current information, and ship support from NOAA's Office of Marine and Aviation Operations (OMAO). Navigation managers can also staff incident command posts as needed, and serve as advisors and conduits for communication between the ICP and NOAA response assets.

Field operations require support from federal, state, and local entities to ensure safe and efficient execution. Navigation response teams are based around the country and require food, fuel, moorage, power, and boarding depending on the response and its location. It is requested that response team leads be put in contact with USCG Station Commanding Officers to ensure their needs will be met before operations begin.

The standard product delivered by navigation response teams is a GeoPDF, which shows depth contours, color maps, positions, and soundings. The standard delivery timeframe for this product is the morning following the end of survey operations, but varies with staffing. Other products may be available to support the U.S Army Corps of Engineers (USACE) depending on navigation response team's resources.

Coast Survey prides itself on its ability to support the USCG and other partners when asked. Do not hesitate to reach out to any of the contacts provided within this document for more information, clarification, or specific guidance.

1. The Navigation Services Team

The primary responsibility of the Navigation Services Division (NSD) is providing customer driven maritime support services to ensure navigational safety, environmental protection, and the efficient and reliable flow of commerce through our waterways. Working with NOAA's Office of Coast Survey, the nation's authority on nautical charts, the NOAA team represents the most experienced hydrographic workforce in the federal government.

- Navigation managers are the regional resource for the complete range of NOAA's Navigation Support Services.
- Navigation Response Teams are distributed nationally and are able to rapidly respond to surveying needs.

Headquarters

NOAA's Office of Coast Survey is headquartered in Silver Spring, Maryland. The uniformed and civilian staff at headquarters oversee budgeting, survey planning, resource acquisition, and are the final say in operational decision making. Personnel at headquarters are also the link when requests to other NOAA resources, such as ships and aircraft, are requested.

Navigation Managers

NOAA's regional [navigation managers](#) are stationed strategically in port areas along U.S. coasts and Great Lakes. They work directly with the USCG, pilot associations, mariners, port authorities, and recreational boaters to help identify navigational challenges facing the marine transportation system and provide resources and services to enable safe and efficient navigation. Navigation managers are the primary point of contact for requesting emergency support.

In addition to providing emergency support, the regional navigation manager can provide:

- Expert navigation preparation and response information for severe weather or hurricane preparedness and post-storm response
- Charting of dangers to navigation
- Assistance in navigational project coordination
- Support for Harbor Safety Committee meetings, or other maritime-related conferences or workshops
- Information about NOAA's latest navigation technologies
- Objective information on hardware and software products for safe navigation and homeland security
- Advice to resolve navigational problems
- Assistance with NOAA nautical charts or data
- Serve as NOAA representative for navigation responses within an incident command post

Through the navigation manager, the Captain of the Port can request assistance from any of NOAA's experts or resources including:

- The [Remote Sensing Division](#) (RSD) which supports response requirements through acquisition and rapid dissemination of a variety of spatially-referenced datasets (stereo photogrammetry and LiDAR) to federal, state, and local government agencies, as well as the general public.
- The Hydrographic Services Division (HSD) which plans and oversees all non-emergency surveys commissioned by NOAA's Office of Coast Survey. These surveys are executed via NOAA's research fleet as well as via private party contract partners. Both of these mechanisms may be available for assistance during an emergency response.
- The NOAA ships operated by NOAA's [Office of Marine and Aviation Operations](#) (OMAO) which provide a wide assortment of hydrographic survey, oceanographic research, and fisheries research capabilities. Within the fleet, four ships are focused on NOAA's hydrographic mission.
- The [Center for Operational Oceanographic Products and Services](#) (CO-OPS), which is the authoritative source for accurate, reliable, and timely water-level and current measurements that support safe and efficient maritime commerce, sound coastal management, and recreation.
- Any of the six [NOAA Line Offices](#) and the 6700+ scientists and engineers dedicated to understanding and stewardship of the environment as well as studying and monitoring our evolving planet.

NOAA Navigation Manager Regions

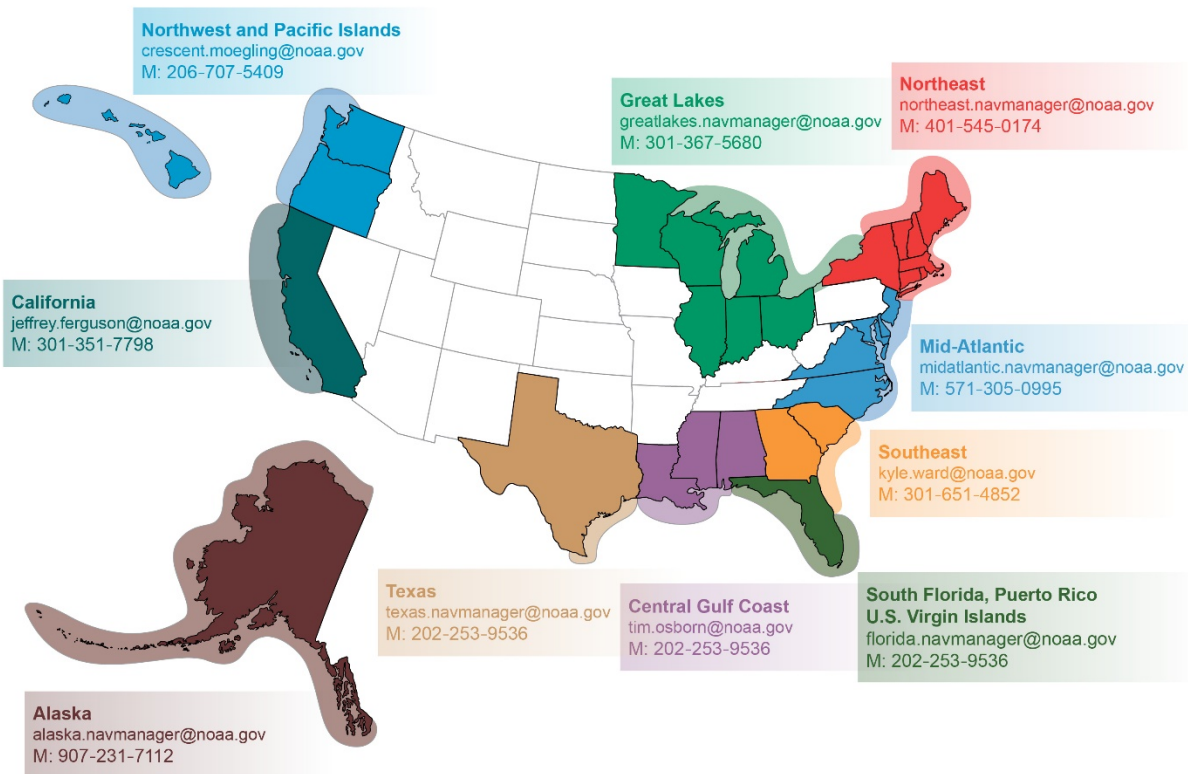


Figure 1: Navigation manager regions of responsibility.

Navigation Response Teams (NRTs)

Coast Survey's mobile [navigation response teams](#) conduct hydrographic surveys to update NOAA's suite of nautical charts. The three-person teams are strategically located around the country and remain on call to respond to emergencies. Their response efforts aim at speeding the resumption of shipping after storms, and protecting life and property from underwater dangers to navigation.



Figure 1: NRT-New London alongside in Burlington, Vermont.

When hurricanes make landfall, they often bring with them stronger-than-normal ocean currents that can shift navigational channels and bring debris that may threaten the ability of vessels to navigate safely along the coast.

Working with Coast Survey's regional navigation managers, NRTs work around-the-clock after a storm acquiring and processing data to speed the reopening of ports and waterways. The teams operate 30 ft. trailer-able survey launches equipped with both multibeam and side scan sonar used to help verify water depth and identify dangers to navigation.

During an emergency response, NRTs provide time-sensitive information to the incident command post, and transmit data to NOAA cartographers for updating Coast Survey's suite of navigational charts. The teams also respond to maritime incidents as needed, such as vessel groundings/sinkings or cargo losses that may require underwater searches to mitigate risk to life and property.

NOAA's NRTs dramatically improve navigation safety, protect homeland security, and speed economic recovery. Like the navigation managers, they are on call to respond to emergencies and are typically able to respond in the continental United States within 48 hours of notification.

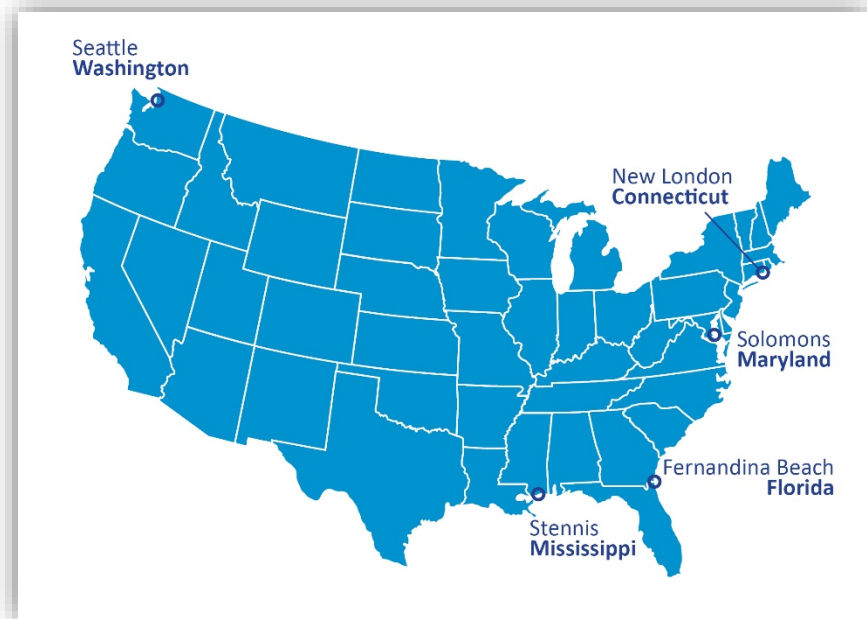


Figure 2: Navigation response team locations.

R/V Bay Hydro II

The R/V *Bay Hydro II*, located in Solomons, Maryland, is the primary survey vessel for the Chesapeake and Delaware Bays and their associated ports. The vessel also acts as a testing platform for Coast Survey. The *Bay Hydro II* can respond to emergencies in her region within 48 hours.



Figure 3: Bay Hydro II.

Mobile Integrated Survey Team (MIST)

Coast Survey maintains two mobile integrated survey team kits for deployment on vessels of opportunity, such as a USCG trailer-able aids to navigation boat. The MIST is a modular system that can be used to collect seafloor imagery and depth soundings. The system includes a mounting pole designed to fit a wide range of vessels. The MIST system fits in the back of a pickup truck and can be shipped overnight.

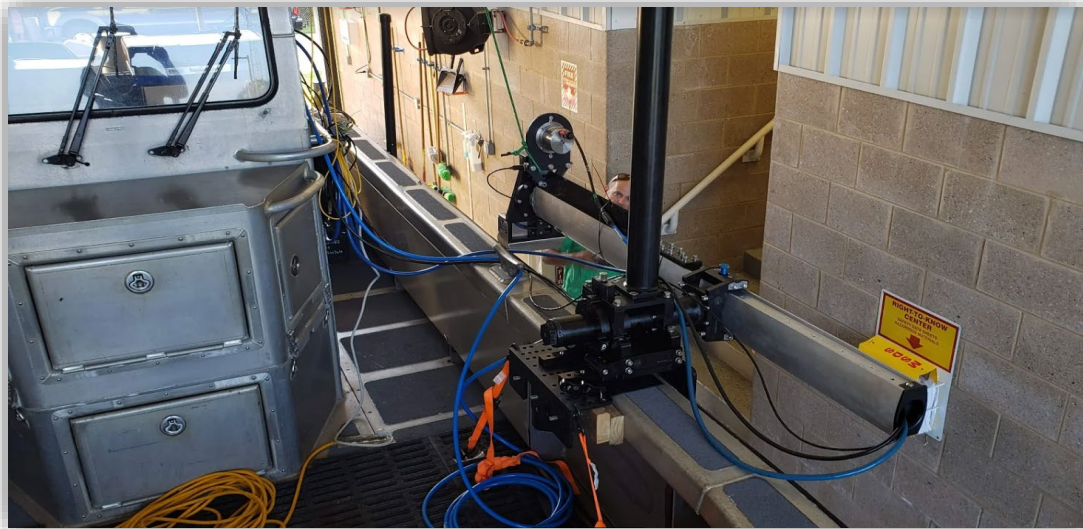


Figure 4: MIST installed on a trailer-able aids to navigation boat.



Figure 5: Portside view of installed MIST.

Autonomous systems

Coast Survey also maintains unmanned surface and subsurface systems which can be deployed either independently or in concert with an NRT as a force multiplier. Work with your regional navigation manager to determine if these assets would be suitable for your desired application or response.



Figure 6: Echobot and NRT-New London in Saint Albans, Vermont.

2. What to expect from Coast Survey during a disaster response

In the incident command post

During disaster responses, Coast Survey's role is to work with constituents to restore safe navigation of affected waterways. The navigation manager is Coast Survey's point of contact at the incident command post and works with the USCG, USACE, and other stakeholders to determine the most effective use of NSD's operational assets. These requests are then forwarded to NSD leadership at headquarters to determine which assets are available for the response effort.

As Coast Survey's representative, the navigation manager works under the incident command post's operations chief with a USACE peer to streamline the priorities according to both the USCG and USACE needs. Once a series of priorities is determined, these are communicated to the field unit (i.e. the NRTs).

During the response, the navigation manager will be the primary point of contact within the incident command post for the field unit. This ensures a smooth dissemination of survey products as well as clear communication of field unit limitations, progress, and requirements to the incident command post.

In the field

The COTP should be aware that all data acquired by the field unit must first be processed and quality controlled prior to distribution within the incident command post. This process takes time, and is dependent on both the amount of surveying accomplished as well as the availability of qualified personnel for processing. The field unit will endeavor to provide products within 12 hours of acquisition, however this may not be practical given personnel constraints. Please work with the regional navigation manager to set expectations at the start of the response operation.

Field units in response situations pride themselves on their ability to effectively and efficiently execute their mission once given surveying instructions. **Logistical support for lodging, mooring, fuel, and other necessities may be required**, however, from federal, state, and local entities to enable these efforts. More details on these requirements are provided in section three of this document.

Products

The standard product that is delivered to the incident command post during a response is a GeoPDF. The GeoPDF allows the user to view the document spatially, with the latitude and longitude of the cursor displayed on the screen. GeoPDFs allow different layers to display independently of each other and without specialized software. For example, a typical GeoPDF delivered to the USCG will have a sounding layer, a layer with contours set at requested depths, a sounding plot layer, and the smallest scale chart. The user is able to turn these independent layers on and off depending on how they want to

view the data. This allows the document to contain a variety of information, but retains the ability to be displayed simply. Please refer to the appendix for a GeoPDF users guide.

Field units can provide XYZ data in a variety of datums.

Survey planning and considerations

Field unit safety is the primary concern, and time must be taken to ensure that survey requests can be conducted safely and efficiently. Following a prioritization of survey areas from the incident command post, the field unit will develop an acquisition plan that codifies acceptable vs unacceptable risk. The risk assessment may result in limitations that require field units to modify acquisition plans, including order or precedent. The field unit will work with the incident command post, via the navigation manager, to communicate these constraints as well as time estimates throughout the response effort.

Survey asset coordination

The navigation manager may also coordinate survey efforts with the USACE in the affected district. While NOAA's survey capabilities are streamlined across our fleet and geared toward insuring safe and efficient navigation, USACE's response is often focused on understanding how they might need to respond with emergency dredging.

USACE survey assets are equipped to support the primary mission of planning, prioritization, and contracting of dredging within a district. Data is used to accurately calculate volumetric measurements of sediment within a channel framework. Understanding the differences between their survey methods and capabilities is important to efficiently prioritize each organization's resources in a response scenario.

USACE will often run single beam echo sounders on predetermined and repeatable tracklines within channels, commonly referred to as "centers and quarters". This method accurately locates shoaled areas where sediment has moved in to the channel. Extrapolating this data gives the USACE an accurate volumetric estimation of sediment in need of removal. However it would not necessarily find an object, like a shipping container which fell between the single beam tracklines.

NOAA's survey methodologies, as explained in the following sections, are designed to map the entirety of the seafloor with specific attention paid to locating objects and other potential hazards to navigation. In post-distaster scenarios, NOAA surveys will provide data that not only shows where shoaling has occurred, but also where objects might have moved into the channel. When data meets object detection requirements, objects as small as 50cm will be found. Singlebeam data can easily miss objects that are not located directly beneath a survey vessel's trackline.

3. Field Unit Specifications and Requirements

- **Navigation Response Team vessel specifications**

- Length: 33 feet
- Beam: 8.5 feet
- Draft: 2 feet
- Air Draft: 10 feet
- Fuel: 160 gallons gasoline
- Crew: 3-4
- Power: 35 amps

- **Requirements**

- Berthing: 3-4 if hotels are not available
- Adequate ramp
- Gasoline, if no public supply available
- Room to store trailer and two vehicles
- Food, if response extends a significant amount of time

- **Bay Hydro II vessel specifications**

- Length: 57 feet
- Beam: 24 feet
- Draft: 6 feet
- Air Draft: 28 feet
- Fuel: 1200 gallons diesel (2-inch fill port)
- Crew: 3-4
- Power: 50 amp, 250 volts

- **Requirements**

- Berthing: 3-4 if hotels are not available
- Diesel, if no public supply available
- Food, if response extends a significant amount of time

- **Mobile Integrated Survey Team specifications**

- 1300-pounds of equipment in 22 Pelican cases
- 1 REMUS 100 ~125 pounds
- 3 small Autonomous Survey Vessels ~150 pounds each

- **Requirements**

- Vessel of opportunity – preferably a trailer-able aids to navigation boat
- 110-volt power or gasoline supply for generator
- Berthing: 3-4 depending if hotels are not available
- Food, if response extends a significant amount of time
- Partial canopy on vessel of opportunity to protect electronics from weather

4. NOAA survey methodologies

Coast Survey utilizes two primary survey methodologies:

- Object detection coverage – this method results in the highest level of data density, paired with the highest standard for statistical confidence in the depth and GPS position of each sounding. Object detection is used in areas of critical under keel clearance, and can be used in depths up to 20 meters.
- Complete coverage – this method results in lower data density, paired with more open standards for statistical confidence in the depth and GPS position of each sounding. Complete coverage is used in areas that do not have critical under keel clearances, and must be used in depths greater than 20 meters.

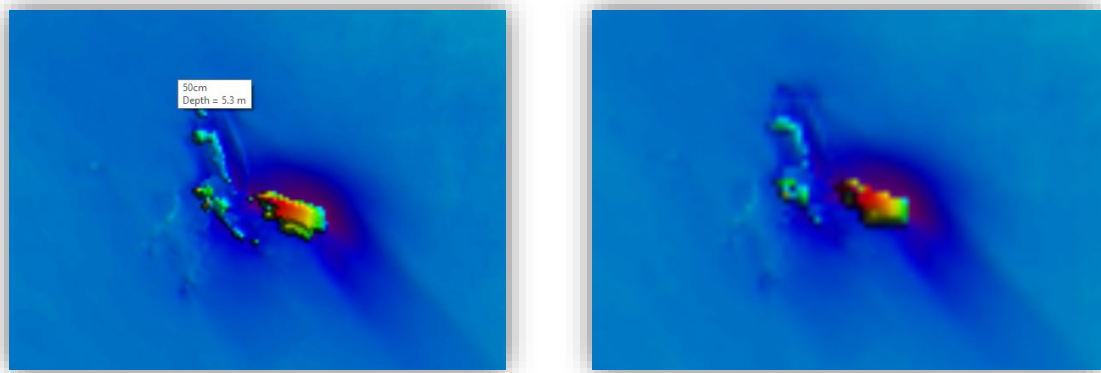


Figure 7: MBES data of F/V Miss Debbie in Calibogue Sound, Georgia. Left image is 50cm resolution (i.e. object detection) while the right image is 1 meter resolution (i.e. complete coverage).

The specific methods for any survey should be determined on mission objective and following consultation with the navigation manager. As a general rule, the higher the accuracy required, the slower data and processing will be.

5. NOAA navigation support between incidents

Routine operations

For a majority of the year when Coast Survey assets are not engaged in emergency response operations they maintain a full schedule of surveying and processing in support of America’s maritime commerce.

If you have or are aware of areas in need of modern surveys, please reach out to your regional navigation manager so that these needs can be documented.

Emergent needs and requests

Coast Survey also provides navigation support for the -USCG outside of large, national emergencies. These incidents could include aiding in the search for sunken vessels that are hindering the flow of traffic or posing an environmental hazard, or providing data that supports CG waterway investigations. To request these services or to inquire about whether we can assist the USCG, please reach out to your regional navigation manager.

6. Appendix

List of Acronyms:

- CO-OPS: Center for Operation Oceanic Products and Services
- CONUS: Continental United States
- COTP: Captain of the Port
- CTD: Conductivity Temperature and Depth (sensor)
- DOC: Department of Commerce
- FOSC: Federal On Scene Coordinator
- GNSS: Global Navigation Satellite Systems
- HSD: Hydrographic Surveys Division
- ICP: Incident Command Post
- IMU: Inertial Measurement Unit
- LiDAR: Light Distance And Ranging
- MBES: Multibeam Echosounder
- MIST: Mobile Integrated Survey Team
- NOAA: National Oceanic and Atmospheric Administration
- NSD: Navigation Services Division
- OCS: Office of Coast Survey
- OMAO: Office of Marine and Aviation Operations
- RSD: Remote Sensing Division
- SBES: Single Beam Echosounder
- SSS: Side Scan Sonar
- TAN-B: Trailer-able Aids to Navigation Boat
- USACE: United States Army Corps of Engineers
- VOOP: Vessel of Opportunity

The history of the Office of Coast Survey

The Office of Coast Survey, or Coast Survey for short, the Nation's first scientific agency, traces its history back to February 10, 1807 when President Thomas Jefferson signed "An Act to provide for surveying the coasts of the United States." After several years under the control of the Department of the Navy, the civilian U.S. Coast Survey was established in 1832, with Ferdinand Hassler as superintendent. Coast Survey has been the nation's chart maker ever since. In addition to conducting hydrographic surveys and producing nautical charts, Coast Survey conducted the first systematic study of the Gulf Stream, designed tidal prediction machines, and established the geodetic connection between the Atlantic and Pacific coasts.

Known as the Coast and Geodetic Survey beginning in 1878, the agency attracted the best and brightest scientists and naturalists who led scientific and engineering activities through the decades. During height of the Great Depression, Coast and Geodetic Survey (C&GS) organized surveying parties and field offices that employed over 10,000 people, including many out-of-work engineers.

In World War II, C&GS sent over 1000 civilian members and more than half of its commissioned officers to the military services. They served as hydrographers, artillery surveyors, cartographers, army engineers, intelligence officers, and geophysicists in all theaters of the war. Civilians on the home front produced over 100 million maps and charts for the Allied Forces. Eleven members of the C&GS gave their lives during the war.

President Richard Nixon formed NOAA in 1970, bringing C&GS into the new scientific agency. Today, the Office of Coast Survey continues its tradition of commitment to employing the highest levels of science and technology to improve marine safety and to tackle the new challenges of the 21st century.

According to the Dictionary of American History, "the Survey is considered to have been one of the major birthplaces of modern American science, including many disciplines not generally associated with geodesy and hydrology. Its creation is a cornerstone of the rapid growth of science and technology and of the development of natural resources for commercial use in the United States."

Organizational charts

- [Office of Coast Survey](#)
- [NOAA Headquarters](#)