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Engineering and Design
POLICIES, GUIDANCE, AND REQUIREMENTS FOR
HYDROGRAPHIC SURVEYING AND MAPPING DIGITAL PRODUCTS

1. Purpose. This Engineer Regulation (ER) establishes general criteria and policy for the execution of hydrographic surveying throughout U.S. Army Corps of Engineers (USACE) river, harbor, and coastal navigation projects, water control projects, and shore protection projects. This ER provides a framework for consistent implementation of hydrographic surveying and mapping techniques, practices, and products throughout the organization.
2. Applicability. This regulation is applicable to all USACE Commands having responsibility for civil works navigation and performing hydrographic surveys, whether in-house or through contracting.
3. Distribution. This regulation is approved for public release; distribution is unlimited.
4. References.
 - a. Engineer Manual (EM) 385-1-1, Safety and Health Requirements Manual.
http://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_385-1-1.pdf
 - b. EM 1110-2-1003, Hydrographic Surveying Manual.
http://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_1110-2-1003.pdf?ver=2014-01-06-155809-307
 - c. EM 1110-2-6055, Inland Electronic Navigational Chart Engineering Manual.
http://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_1110-2-6055.pdf
 - d. ER 1130-2-520, Navigation and Dredging Operations and Maintenance Policies.
http://www.publications.usace.army.mil/Portals/76/Publications/EngineerPamphlets/EP_1130-2-520.pdf?ver=2013-08-22-104518-357
 - e. USACE Daily Tasking Order 16-02-22. https://team.usace.army.mil/sites/HQ-CO/PDT/HQ-G33/Lists/Orders%20Log/Attachments/1820/USACE%20Daily%20Tasking%20Order%2016-02-22_signed.pdf

5. Hydrographic Surveys.

a. General.

(1) Hydrographic surveys performed in-house and through contracts must be executed consistent with reference 4.b. Reference 4.b. is the technical criteria and guidance for performing hydrographic surveys with USACE hired-labor forces or contracted survey forces and should be directly referenced in specifications for contracted construction, dredging, or Architect-Engineer (AE) services.

(2) Reference 4.b. continues to be updated to include the best practices for performing the most efficient and accurate hydrographic data acquisition and processing. However, many of the mandatory requirements found in previous versions of reference 4.b. have been largely eliminated. USACE Districts determine the most efficient and accurate methods for hydrographic data acquisition and processing while adhering to guidelines found in this ER and reference 4.b.

b. Post Dredge Surveys.

(1) Post Dredge or After Dredge (AD) surveys are defined by USACE as any hydrographic survey performed after completion of dredging operations in a reach or channel area. AD surveys are performed by the government as soon as possible after dredging in a reach or acceptance section is completed - generally within five (5) business days. Final survey plots and quantity computations are typically required within three (3) business days of the survey in order to release the dredge to other work. Once an AD survey is complete and preliminary quality assurance and quality control checks (QA/QC) are performed, it is highly recommended to disseminate the survey plot to the dredge contractor. It is understood that a preliminary survey may change; however, providing it to the contractor early will help to resolve potential issues.

(2) In many cases, the AD survey reveals that not all material has been removed. As such, subsequent dredging, along with re-surveys, must be performed before final clearance/acceptance is verified. Further, repeated full-coverage channel sweep surveys must be performed to locate and remove material or man-made objects above grade before final clearance/acceptance is verified. Any more than two (2) additional final AD surveys will be performed at the contractor's expense.

(3) It is highly preferred that AD surveys be performed using in-house government labor or by an independent contractor; one that was not involved with the dredging operation. In order for contractor data to be deemed acceptable for use as AD data, the contractor's data must be submitted to a district representative responsible for QA/QC purposes within three (3) days of completion of field survey operations.

(4) Contract disputes over remaining material above the required depth typically involve the positional and depth measurement accuracy capabilities of the survey, or basic disparity between in-house and dredging contractor surveys. These disputes often involve shoal material or objects that may be within the achievable tolerances of acoustic sounding equipment. In many cases, repeated surveys of these shoal areas yield different results, or may not agree with those performed by the dredging contractor's survey crew. As such, government supplied surveys must prevail based on

adherence to reference 4.b. and on stated accuracy capabilities found therein. Specification of types of survey equipment to be used, calibration procedures, and survey procedures must be clearly stated in the dredging contract to avoid disputes. Additionally, it is preferred that the Government surveyors be included in the pre-construction conference in order to discuss survey related issues directly with the dredging contractor and/or the contractor's hydrographic survey representative before dredging operations begin.

c. Beach Surveys and Safety Procedures.

(1) Effective management of beach and nearshore resources requires survey data for the entire active beach system to accurately quantify changes in morphology, shoreline change rates, and volumetric change associated with changes in natural coastal systems and engineering projects. To maximize the opportunity to acquire overlapping surf zone data, topographic surveys are conducted as far into the water as possible during low tide and hydrographic survey data is collected at high tide.

(a) If sea conditions are calm and deemed safe, by the Site Safety Health Officer (SSHO), a survey boat may safely acquire data in the surf zone.

(b) If conditions are not safe to operate a survey boat in the surf zone, extrapolation or interpolation techniques can be utilized to estimate beach morphology and calculate volumes seaward of the area of acquired topographic data. Considerations for applying extrapolation techniques should include information such as historical beach profile data, morphology of the native and engineered beach, and grain size. Interpolation techniques can be applied if hydrographic data was acquired offshore but overlap of topographic and hydrographic data was not achieved due to unsafe surf zone conditions. Considerations for applying interpolation techniques are similar to those of extrapolation techniques and are highly dependent on the location and size of the nearshore bars and troughs.

(c) If conditions are not safe to operate a boat in the surf zone, another option that can be considered for beach nourishment construction projects is to initially place the material above a pre-defined elevation (e.g., mean sea level, mean high water) to minimize the need for surf zone surveys to determine volume for payment.

(2) If a District's Chief of Survey determines that methods outlined in section 5.c.1. are not feasible, beach morphology is not conducive, or the sea conditions are not safe for a survey boat in the surf zone, the Chief of Survey can request permission from the District Safety Officer for surveys to be performed with a swimmer on a per project, case by case basis. If a Contractor is conducting the survey, the Contractor must coordinate with the Contracting Officer's Representative (COR) and District Safety officer to request permission to perform surveys with a swimmer on a per project, case by case basis. If a swimmer is to be used, the following swimmer protocol must be adhered to as well as compliance with procedures outlined in reference 4.a.

(a) No swimmer will be in the surf zone beyond wading depth when wave heights are greater than 6 feet or deemed unsafe by the Site Safety Health Officer (SSHO) and surveying officials.

(b) Two certified lifeguards (certified by Red Cross or United States Lifesaving Association) with experience in coastal environments must be present for all data acquisition. One lifeguard (hence forth known as the survey swimmer) will swim to acquire survey data and the observing lifeguard (hence forth known as the standby swimmer) will serve as a safety observer and survey swimmer rescue. The survey swimmer will enter the water with appropriate safety equipment and a survey rod or project specific light survey equipment, while the observing lifeguard will remain onshore directing the survey swimmer and observing at all times for signs of distress or danger. The standby swimmer will be equipped for immediate entry into the water and will have rescue equipment within 20 feet and ready for use. The standby swimmer will move parallel to shore and maintain visible contact with the survey swimmer to maintain the shortest distance to the survey swimmer at all times.

(c) A complete Hazard Assessment, conducted daily by the SSHO, is required for all surf zone activities.

(d) All incidents affecting swimmer safety will be reported to the SSHO at the end of the survey day. A plan of action to mitigate future instances of said incident will be formulated and implemented before swimmers will be allowed to enter the water for additional survey operations.

6. Volume Calculations Performed for Dredge Payment. Volume Calculations must be performed using the most accurate method for the specific type of equipment used during the survey. Special care must be taken to avoid under/over reporting of volume in situations where there is complex channel geometry. Specific guidelines and examples can be found in reference 4.b. and below.

a. Single Beam – Districts utilizing single beam sonars for volume calculations must use the average end area (AEA) method. See reference 4.b. for AEA methods available.

b. Multi-transducer – Districts utilizing multi-transducer systems must use surface-to-surface volume computation techniques, which includes Tringulated Irregular Network and surface grid modeling procedures.

c. Multi-beam – Districts utilizing multi-beam or interferometric sonar must use a surface-to-surface method to determine payment volumes. The matrix size (point spacing) must not be larger than 5x5 feet.

7. Support to National Programs and Data Management. The Inland Electronic Navigational Charts (IENC) Program, the eHydro Program, and the National Coastal Mapping Program (NCMP) produce hydrographic survey and digital mapping data used internally and outside of USACE by other agencies, commercial interests, and the public. The use of these programs is mandated. Therefore, hydrographic survey data and digital mapping products produced through these efforts must be supported, integrated, and managed at the District level for use by internal and external programs for planning purposes.

a. IENC.

(1) The IENC program is responsible for the production and publication of IENC for all inland commercially navigable rivers. Electronic Navigational Charts (ENC) are digital chart products that follow data structures, currently known as S-57 or S-100, from the International Hydrographic Organization (IHO), and are intended for the safety and efficiency of navigation. The IENC standard is based on IHO S-57 with added extensions for features unique to inland waterways. More detailed information regarding the IENC standard and chart downloads can be found at www.ienccloud.us.

(2) Production and publication of any IENC or ENC, which includes products for coastal waterways, must be coordinated through the IENC program. In order to eliminate confusion and ensure accurate data is released to the public, commercial industry, and agency partners; district offices must not distribute IENC products on their district servers and web sites. All IENC and ENC products must be distributed through the official IENC web site www.ienccloud.us.

(3) For IENC updates, Districts must submit all new source data to the IENC Quality Assurance manager. Charts are updated and maintained on a monthly basis, so all new source data submitted must be incorporated in the next month's update which will be published on the 1st business day of the month.

b. eHydro.

(1) eHydro is an automated process to catalog, report, and disseminate hydrographic survey data for navigation channels through an enterprise system. The eHydro Program was developed to process and manage coastal channel and hydrographic survey data from each district into standardized sets of geospatial data. Additionally, the process provides the automation of uploading the data to an enterprise system which enables performance-based and budgeting analysis to be performed in a uniform and timely manner. As of 15 JUL 2016, all high and moderate-use coastal channel data and related condition or after-dredge hydrographic survey data sets are to be processed and uploaded to the enterprise system through the eHydro desktop tool kit.

(2) eHydro maintains and disseminates data to support two navigation channel products:

(a) National Channel Framework (NCF). eHydro is used to store and maintain the NCF, an enterprise Geographic Information System database providing information about Congressionally authorized coastal navigation channels maintained by USACE. The NCF is described as including the following geospatial features: centerlines, station lines, toe lines, as well as quarter and reach polygons as specified in reference 4.b. Note: High-use is defined as annual channel tonnage above 10 million tons. Moderate-use is defined as annual channel tonnage between 1 and 10 millions tons. Low-use is defined as annual channel tonnage less than 1 million tons. Tonnage values are determined from the National Waterway Network (<http://www.navigationdatacenter.us/data/datanwn.htm>).

(b) Channel Condition Information (CCI). eHydro produces structured, standardized data sets which describe bathymetric conditions from district provided hydrographic survey data (e.g.

condition and AD survey data). The structured data includes, but is not limited to, soundings, project depth contours, and shoal polygons, which are referenced to the NCF for context to navigation. Additional data products to support CCI include channel survey plot sheets, tabular Channel Condition Reports (CCR), and metadata files.

(3) Requirements and Milestones for districts with coastal navigation interests:

(a) High and moderate-use channel geometry data comprising the NCF (see paragraph 7.b.2.a.) are to be actively included in eHydro, with low-use coastal channel geometry data to be included no later than 01 SEP 2017. Updates to any channel geometry or attribute data must be processed and uploaded through the eHydro process within two (2) weeks of change or update.

(b) Hydrographic surveys performed or conducted after 15 JUL 2016 to assess and determine channel conditions or after-dredge conditions must be entered in eHydro and uploaded to the enterprise system (see paragraph 7.b.2.b), with coastal low-use hydrographic surveys to be included into the process no later than 01 NOV 2017. These hydrographic surveys must be processed and uploaded within five (5) business days after the completion of QA/QC process for the channel, reach, or acceptance section survey data sets.

(c) Additional coastal hydrographic survey requirements include processing and uploading the past five (5) years of channel condition surveys for;

(i) High and moderate-use was to be completed no later than 31 DEC 2016.

(ii) Low-use must be completed no later than 01 AUG 2018.

(4) Completeness of data and operational status will be determined and measured on the above requirements and milestones being satisfied. This data and its timeliness are the responsibility of each district. Additional metrics include:

(a) Metadata for each and every survey.

(b) NCF geometry and attribute agreement.

(5) Districts must ensure that any maps or data products indicating channel conditions or depicting channel locations that are provided to outside interests do not conflict with eHydro NCF and coastal CCI. For example, a plotsheet showing least depths within the channel must agree with the tabular values in the eHydro CCR. Note that the simplest and most certain method of ensuring consistency is to produce all channel condition products for outside users through the eHydro process.

(6) The eHydro development team performs quality assurance checks on the uploaded data, and makes the channel information available to end users, including other federal agencies, through a single data portal. The development team also maintains the application used by the districts, and provides training and technical assistance to districts. Enterprise data and outputs will be available within 24 hours of being uploaded to the enterprise system. This will include making the NCF, all

hydrographic survey data, and all other eHydro products and reports. All data will be made available through the Navigation Data Information Framework website at <http://navigation.usace.army.mil/DIF/Explore> under the Survey and Mapping section.

c. NCMP. The NCMP provides regional and project surveying and mapping products based on data from four integrated sensors; topographic lidar, bathymetric lidar, color photogrammetry, and hyperspectral imagery. The NCMP covers the US coastal zone once every five years and districts are asked to participate in the surveying and mapping planning so that priority areas and needs are covered. The NCMP is managed through the Joint Airborne Lidar Bathymetry Technical Center of Expertise (JALBTCX), a partnership between the U.S. Army Corps of Engineers, the U.S. Naval Oceanographic Office, National Oceanic and Atmospheric Administration, and the U.S. Geological Survey. For more information see www.jalbtex.org.

(1) The standard survey products include topographic and bathymetric digital elevation maps (DEM), high resolution imagery, land use maps, volume differences since the last survey, changes in high water shore line, and other products that are Spatial Data Standards for Facilities, Infrastructure, and Environment (SDSFIE) compliant and ready for use in your eGIS tools. Elevations and imagery may be downloaded at <https://coast.noaa.gov/digitalcoast/>.

(2) The districts will participate in NCMP survey planning by making available legacy survey data for the specified areas. Survey planning is initiated approximately 6 months prior to flights. The District Coastal Working Group, Regional Sediment Management Point of Contact, and Operations Division will be contacted by the NCMP to begin the process.

8. Proponency and Responsibility. The proponents for this regulation in the HQUSACE Directorate of Civil Works are the Engineering & Construction Community of Practice (COP) (CECW-CE) and the Operations and Regulatory COP (CECW-CO). Program or Project Managers leading designated project delivery teams are responsible for ensuring that the requirements in this regulation are met.

FOR THE COMMANDER:


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