

# Evolution of U.S. Water Transportation Data and Statistics

## Responding to 21st-Century User Needs

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**D**ecision makers involved in water transportation, from the daily operator to the headquarters visionary, must have current, flexible, readily available, internally linked, and standardized data and statistics for timely, intelligent decision making. Operating personnel, whether at a lock and dam or on a vessel, need data to make such operational decisions as the best tow configuration or the optimal sequencing of tow cuts through a lock. Project managers must have data with which to assess their operators' procedures, advising them of limitations and best practices. Programming personnel require data to modify decisions such as the extent and depth of channel dredging, length of season, or number of supported shifts. The executive must have the data needed to view decisions from the perspective of budgets, performance, and results on regional and national scales.

The key features required of these data are flexibility, accessibility, timeliness, and currency. Just 10 years ago, the database systems of most agencies failed on all these counts. Today, U.S. water transportation databases are taking shape as an integrated system after a decade of reworking definitions; standardizing terms; adopting international and national standards and codes; and converting to compatible hardware, software, and communications systems. This article examines the various water transportation databases, the data they contain, current uses of these data, means by which users can access and integrate the data, and how the data meet the needs of today's expanding user community.

## Water Transportation Databases

The U.S. Army Corps of Engineers has responsibility at the federal level for operating, maintaining, and developing nearly 41,800 kilometers (26,000 miles) of federal channels to ensure efficient and safe passage for commercial and recreational vessels. Congress therefore charged the Corps to be the central agent for the collection, processing, and production of data and statistics for U.S. waterways. Within the Corps this responsibility resides with the Navigation Data Center (NDC), which has offices in Alexandria, Virginia, and New Orleans, Louisiana. The data captured portray the physical attributes, level of use, and performance of the nation's commercially active waterways.

Nearly 2.1 billion metric tons (2.3 billion short tons) of commerce takes place annually on U.S. channels. These waterways are fundamental to the U.S. and world economies and in particular to the global competitiveness of the United States. More than 99 percent of all U.S. overseas foreign trade, by volume, utilizes the deep-draft channels. More than half of all export grain and soybean shipments move by barge on the inland waterways system. Each movement averages 1770 kilometers (1,100 miles). National security is also deeply routed in water transportation. The military moves personnel and materiel to points of engagement around the world from multiple U.S. ports of embarkation.

The individual federal water transportation databases contain data on lock, port, and waterway infrastructure; commercial U.S. vessel statistics and vessel movements; waterborne commerce;

lock operations and performance; and dredging. These data are publicly available; however, proprietary elements are limited to federal users by the Federal Trade Secrets Act.

### **Infrastructure**

Four databases contain data on lock, port, and waterway infrastructure.

**Waterway and Port Facilities.** The Corps' responsibility for surveying port and waterway terminal and transfer facilities served by federal channels began with authorizing legislation in 1918 and 1920. These waterway-dependent facilities, along with vessels serving them, are the most visible elements of the water transportation system, offering an American blend of private and public services. They serve as the link among inland transport modes, the commodity, the passenger, and the vessel.

Today, 57 reports and a corresponding electronic database capture information on more than 200 coastal, Great Lakes, and inland port and terminal areas embracing nearly 10,000 waterfront facilities. Each printed report includes photographs, detailed descriptions of the facilities, and an aerial mosaic map of the port or waterway area. Most reports are updated once a decade, although some rapidly changing areas warrant more frequent updates. Plans are under way to fully automate this program and integrate it into the data systems of the Corps and the Department of Defense (scheduled for fiscal year 1999), and to increase the update frequency of key data elements. Detailed information within the current database includes facility location (latitude and longitude, county, state, river or waterway, river mile, and bank); facility owner, operator, and point of contact; type of structure and construction; vessel accommodations; rail and highway access; utilities (e.g., water, electricity); and fire protection. The report also includes information on berthing, cranes, transit sheds, grain elevators, marine repair plants, fleeting areas, docking and storage facilities, and other unique features.

**Lock Characteristics.** The Corps owns or operates 275 lock chambers throughout the United States. This database contains data on the physical aspects of these locks. These data include the location; physical characteristics such as length, width, lift, depth, and gate type; site information, including the lock operator and phone number; site characteristics, including channel length and width, pool length, and moorings; a record of historical changes; and management information.

**National Waterway Network.** This digitized geographic database of the navigable waterways and coastways in and around the United States at 1/100,000 scale was developed as a multiagency project. It is now maintained by NDC and is used for mapping, compilation of commodity flow statistics, and analytical studies.

**Mile Point Locations.** Contained in this database are 10,020 sequential mile point positions of navigable inland and intracoastal waterways. Each record includes the longitude; latitude; river name, code, and number; and ID number. This database was a joint endeavor of the Corps and the Defense Mapping Agency and is maintained by NDC.

Ongoing uses of these four nationally consistent waterway infrastructure databases include (1) estimation of the impacts of natural disasters, such as impacts on the Mississippi River during the 1988 drought and 1993 flood; (2) ongoing reservoir management decision making, which involves the identification of facility elevations; (3) assessment and justification of channel modifications or abandonments; (4) analysis of facility capabilities for military mobilization support; (5) permit reviews; (6) private industry assessment of potential port and waterway support services, requirements, and needs; and (7) government assessment of on-the-spot and post-hurricane emergency needs. Using the data collectively, national policy makers can assess the nation's coal export sites, grain elevator capacity, and oil-handling facilities and their storage capacities. They can also answer such questions as the number and location of coal-burning power plants with barge-receiving equipment. The Corps' navigation data management system requires site surveys that provide verification of dock locations and services, an essential control for monitoring waterborne commerce activities. Knowledge of this massive private and public infrastructure supports decisions on federal channel modifications, highway access requirements, and military logistics, as well as private- and public-sector port and port-related investment decisions.

### **Vessels**

The Corps surveys all U.S. vessel companies annually to determine the fleet of U.S. vessels, such as ships, towboats, and barges, available for commercial waterborne carriage of passengers and freight. Specific types of operator and vessel data collected include operator address; type of service and principal commodities carried; localities served; vessel name and number; U.S. Coast

Guard number; and vessel characteristics, such as vessel type, net registered tonnage, construction and characteristics, length, breadth, draft, horsepower, highest fixed point, carrying capacity, cargo-handling equipment, year built or rebuilt, and vessel operating base. Vessels are classified by construction type using the international vessel classification system.

The primary purpose of this database is to provide an annual benchmark for ensuring that the vessel owners or operators report commerce and vessel moves on a monthly basis to NDC's Waterborne Commerce Statistics Center in New Orleans, Louisiana. Other uses range from the military's identification of vessels for contracting services to the private sector's analysis for vessel-support services.

### **Waterborne Commerce**

The Corps' long-term practice (since 1864) of monitoring vessels and commerce on Corps-maintained channels was formalized in 1922. Congress charged the Corps to collect, manage, and distribute data on the movement of vessels and cargo transported on the navigable waterways of the United States. In 1947 the collection and initial processing of data on vessels and cargo having a foreign origin and/or destination was shifted to U.S. Customs and the U.S. Bureau of the Census, respectively, under an agreement arranged by the Bureau of the Budget, predecessor of the current Office of Management and Budget. Responsibility for U.S. foreign waterborne transportation statistics is currently being shifted back to the Corps with support from the Maritime Adminis-

tration and U.S. Customs. The Corps will then be responsible for both domestic and U.S. foreign waterborne commerce statistics. Data on U.S. exports and vessel movements from the United States to Canada are supplied by Statistics Canada in an exchange that began in 1990.

**Domestic Data.** Domestic commerce is defined as commerce originating and terminating on waters of the contiguous and noncontiguous U.S. states and territories. Domestic vessel operating companies must furnish information about the movement of each of their vessels by origin and destination on a monthly basis. Specific types of data collected include vessel name; vessel type; commodity carried; tonnage; port, dock, date departed, and draft for each origin and destination; alternate routes transited; and, for vessels using deep draft channels and not paying the inland waterway user fee, shipper name and Internal Revenue Service number. Vessels that remain idle during the reporting period must also report. The Corps pledges confidentiality to operators for individual movements, and therefore releases data to the public only as aggregate statistics. Detailed commodity codes used are based on the Standard Industrial Trade Classification, Revision 3, which is compatible with the International Harmonized System. This facilitates direct correspondence with U.S. foreign trade statistics.

**Foreign Data.** Foreign commerce may involve an import, export, or transshipment. Until 1997, the Census Bureau had compiled and disseminated these data. In June 1997 the Census Bureau terminated processing of transshipments, and it will cease processing of the remaining data in September 1998 when the mission shifts to the Corps. The specific data include commodity, weight, value, vessel, U.S. district/port, foreign port, country of origin/destination, draft, net registered tonnage, ballast rig, operator, and flag. Beginning in 1998, Customs will capture the dock of arrival or departure at most U.S. ports.

The Corps applies a routing routine to both foreign and domestic commodity and vessel movements, and thereby creates an integrated file and summary statistics for all waterborne commerce and vessel movements. These data allow for the preparation of national waterborne commerce statistics; monthly estimates by inland waterway and for major commodities; commerce and vessel activity by state, by waterway, by Corps project, and by port; and origin-destination tables for 26 geographical regions by commodity group. A recent sampling of requests from the Corps and various federal offices includes specific mile-by-mile traffic on the Missouri River; foreign and

## **Comment from a Data User**

JAMES MCCARVILLE

The development of cargo marketing efforts on the inland waterways has long been hampered by disparate data sources and the barge-like speed of data availability. This article by Arlene L. Dietz highlights important steps taken by the U.S. Army Corps of Engineers to make Corps, U.S. Customs, and other waterway data sources available in an easier, integrated, and more timely manner. It is to be hoped that this trend to integrate multimodal origin/destination and export/import data will continue in the future when the Corps assumes responsibility for both domestic and U.S. foreign waterborne commerce statistics. What is needed now is a public education effort regarding the availability of the data and tutorial documentation to assist new users.

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domestic movements by commodity and vessel on the lower Columbia River; volume of petroleum moving by water near sensitive wildlife refuges; and density of hazardous product movements associated with water intakes on the Ohio River. New system designs, software, and hardware emerging in the 1990s have facilitated the ability to respond to such tailored queries.

### **Lock Operations and Performance**

The Corps standardized and centralized its lock-monitoring programs in 1975 with the national Lock Performance Monitoring System. Most Corps-owned and/or -operated locks now collect common data fields and upload the results on a monthly basis into a central computer system. The data are kept active for the last 10 years, with archived data being accessible back to 1980. Data are collected by the lock operator for each lockage and/or lock gate activity, and include the vessel name, number, and type; number of barges and direction of travel; number of cuts; lockage type; arrival, entry, and exit type and time; lockage time; lock unavailability; assisting vessel name; flotilla dimensions; number of commercial passengers; barge type and dimensions; and commodity type and tonnage. Also recorded are detailed management data, such as lock closure dates and times, durations, and causes, and whether closure was scheduled.

The Corps lock operators, as well as commercial towing companies, access these performance data to judge the performance of a lock, vessel, or individual operator. Similarly, management uses these nationally consistent performance data to evaluate practices at one lock as compared with practices at other locks. Planners can study these data and make recommendations for changes to enhance a lock's efficiency. For example, the locking time and delays associated with double- and triple-locking large tows are judged against costs of operating several single tows or against different sequencing protocols of cuts through a lock. Statistics on locking times and delays help managers at all levels within both the public and private sectors assess options for reducing delays.

### **Dredging**

The Corps has collected dredging data in various forms for many decades. However, the maintenance of a national database was sporadic until 1991. At that time the Corps' Director of Civil Works charged NDC to establish and maintain a national dredging database. This database meets the criteria of offering timely, current, accurate, and accessible

data for both the Corps and industry. Currently it tracks all contracted and Corps-performed dredging from prebid through completion. Included are data on location of dredging and disposal sites; dredged quantity; type of dredge; type of disposal; dates of bid advertisement, bid opening, and contract award; units of contract measurement; small-business set-aside restrictions; government cost estimate; all bids; winning bidder; business status of bidders; and actual contract cost and quantity dredged. The flexibility of this database is its greatest asset.

The Corps' Small Business Office routinely uses the data in this database to monitor the number of small-business bidders and winners. Auditors use the data in routinely evaluating the bidding process. Both districts and industry monitor dredge activities to assist in preparing and responding to bid advertisements. The administration continually reassesses the relevant data, at the request of Congress, to evaluate the need for federal dredges, and the type of disposal by volume and region is monitored at multiple levels.

## **Integrated Navigation Information**

Each of the above water transportation databases addresses a specific area of navigation—infrastructure, use, or performance. Through the adoption of uniform terms and codes (e.g., location, commodity, and vessel), present technology allows the linking of selected datasets to provide an integrated perspective at a point in the navigation system (such as a dock); a reach, such as Houston Ship Channel; a region, such as the Gulf Coast; or the nation.

Uniform geographic coding allows analysts to use tools such as geographic information systems (GIS) technology to correlate data from multiple databases. For example, if an analyst merged information on chemical products moving on U.S. waterways and coastways with the physical system map, the volume passing all points in the physical system would appear as a commodity flow map. An example is shown in Figure 1, which is an extract from the entire United States. Displaying tonnage adds a second layer of information. Third and fourth layers of information could be added; however, the printed national and regional maps would be too detailed at the scale required here. Decision makers often want to see tons of commerce or frequency of vessel activity, both measures of use, compared with the costs of dredging for the nation's waterways. Using GIS

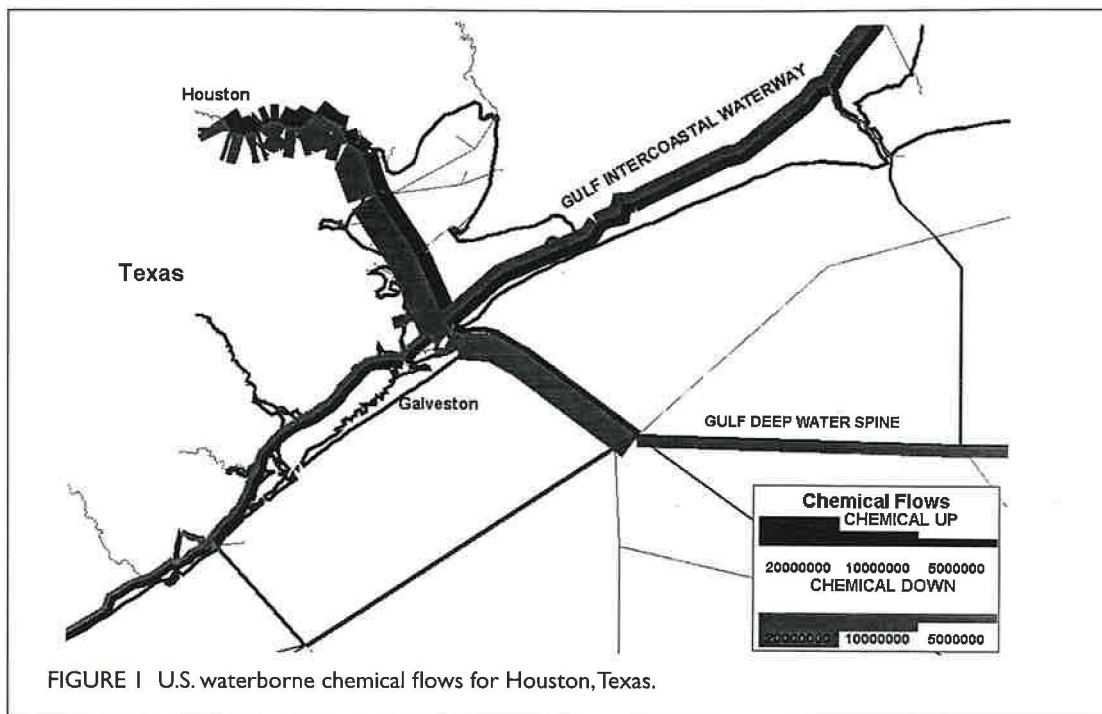


FIGURE 1 U.S. waterborne chemical flows for Houston, Texas.

and NDC data, Corps analysts can focus on a single reach within the system, such as the Houston Ship Channel; on the closest dredging site; or on individual facilities.

The monthly snapshot of commodity movements through locks effectively uses historical waterborne commerce with the appropriate application of statistical techniques to create timely, monthly estimates of internal waterway traffic overall and for key commodities. Figure 2 displays the Internal Lock Indicator of Petroleum and

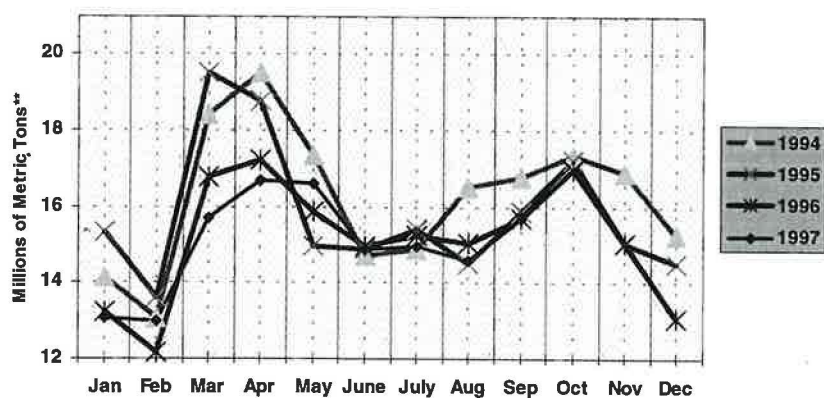


FIGURE 2 Internal Lock Indicator of Petroleum and Chemicals (millions of metric tons by month, 1994–1997).\*

\* Internal: moved solely within U.S. boundaries. Cumulative September to August tonnage (in millions) is, for 1994–1995, 610; for 1995–1996, 602; for 1996–1997, 576 (- 4.3 percent from 1995 to 1996).

\*\* Multiply by 1.10231 to convert to short tons.

Chemicals by month for the years 1994 through 1997.

Use of NDC's integrated navigation data during the 1993 Mississippi River flood emergency allowed the Corps, the Federal Emergency Management Agency, and the states to quickly identify port facilities, lock operations, and specific cargo carrier companies—with their vessels, commodities, and tonnage—affected by the flood. Dredging cost histories from NDC gave estimators and Corps contracting offices the basic documentation needed to speed evaluation and award of emergency dredging and dike repair contracts.

Nationally standardized and integrated navigation databases have tremendous value. They provide many of the required performance measures of navigation activities mandated by Congress and directly contribute to the federal government's ability to manage for results in the area of navigation services.

## Data Access

The latest data access technology, coupled with NDC's standardized terms and links, allows customized products to be formed quickly from the NDC data warehouse. Providing a better perspective of the total U.S. waterway navigation system is the primary goal for this integration capability. Ensuring easy access to this information is an essential prerequisite. As an example, all of NDC's

publications are available on one CD, which is distributed free of charge. This CD also includes the aggregated data used to create these publications, as well as related data from other federal agencies, such as the U.S. Coast Guard and the Bureau of the Census. Presented in standard file formats, the data are ready for importation into database tools, spreadsheets, or GIS for further analysis and/or visualization.

Those needing current information, such as monthly waterway indicators, key lock statistics, or dredging bid openings or contracts, or those wishing to be kept up to date on new integrated navigation data products, can access NDC's Web site: <<http://www.wrc-ndc.usace.army.mil>>. This site offers links to other navigation-related Web sites as well.

Given the uses of NDC data products, paper copies have not become obsolete. NDC is engaged with the U.S. Government Printing Office in a feasibility assessment of on-demand printing, its quality and its costs, in an effort to reduce future printing inventories of the Corps' 65 standard printed reports.

## Conclusion

Users of water transportation data face a number of challenges, including reduced budgets; manpower cuts; the call for performance-based, results-oriented management; the need for contingency planning; and ongoing emergency response requirements. These challenges have generated a pressing need for easier, more efficient access to better, more comprehensive data. This need is being met by an integrated, standardized national navigation data system linked geographically, with common access, and using common terms. As a result all users—from site operators seeking to improve operational efficiency to the President of the United States assessing the impacts of a natural disaster—will have access to the data they require to make better, more informed decisions.

## Importance of U.S. Port System New U.S. Army Corps of Engineers Report

ROBERT PIETROWSKY

The U.S. national economy is becoming increasingly interdependent with the global marketplace. During the last 20 years, U.S. foreign trade has increased to the point where it now accounts for about one-fifth of the U.S. gross domestic product. The U.S. port system provides the critical link in the nation's intermodal freight transportation network.

Recognizing that a modern port infrastructure is vital to maintaining the nation's status as an economic superpower, the U.S. Army Corps of Engineers' Institute for Water Resources (IWR) recently completed a study examining the flow of foreign trade through 88 ports across the United States. The resulting report, *The Importance of the U.S. Port System*, uses a series of color geographical displays to provide a summary of economic information highlighting the importance of the port system to imports and exports. Average foreign trade statistics for 1993–1994 are displayed at three levels: national, commodity, and state.

The foreign trade data presented include cargo tonnages and values and numbers of containerized 20-foot equivalent units (TEUs) moving through U.S. ports to and from each state. A separate section of displays highlights the primary international trading region of each state, the state's most important import and export commodities, and the number of ports supporting the state's foreign trade activities.

The report reveals that most states are served by approximately 15 different ports, many outside their own state boundaries. These results serve as a reminder that the network of U.S. ports is a system that truly serves the entire nation, providing shippers and carriers across the United States and worldwide with the intermodal and economic efficiencies needed to maintain a robust economy.

The study results have been published both in hard copy and on CD-ROM. For further information contact Phil Thorpe, IWR (telephone: 703-428-7074). Copies of the report or CD-ROM may be ordered by contacting Arlene Nurthen, IWR Publications (e-mail: [arlene.nurthen@hq.usace.army.mil](mailto:arlene.nurthen@hq.usace.army.mil); fax: 703-428-8171).

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