ERDC/TN DOTS-23-1
March 2023

Automatic Identification System (AIS) Data Case Study: Vessel Traffic through the Yaquina Bay Breakwater at Newport, Oregon

by Marin M. Kress

PURPOSE: The navigation staff at US Army Corps of Engineers (USACE) Portland District (NWP) asked for information on vessel transits through the two existing openings in the breakwater on the north side of Yaquina Bay in Newport, Oregon. Currently, no authorized federal channel passes through the breakwater openings; however, the design for a possible federal channel is under consideration. NWP staff were interested in historical vessel transits, with a special focus on isolating transits for the largest (i.e., longest) vessels, identified as vessels 80 feet or longer, currently utilizing the area inside the breakwater. The Automatic Identification System Analysis Package (AISAP) software created by USACE-ERDC (2018) was used to analyze vessel traffic.

INTRODUCTION: Understanding commercial waterway utilization is fundamental to USACE's navigation program. Information on how vessels currently transit through the breakwater entrance at the Newport, Oregon, commercial marina will assist with evaluating and selecting a potential design vessel for use in a potential channel design. The Automatic Identification System (AIS) on a vessel provides a series of individual position reports that can be joined together to re-create a historical trackline for a given vessel and timespan. Detailed information about AIS messages and technical standards is available from international governing bodies (e.g., IALA 2008; IEC 2001; ITU-R 2014; PIANC 2019) and the US Coast Guard (USCG), which regulates AIS carriage in US waters (USCG, n.d.; US CFR 2019). Figure 1 shows an example of re-created vessel tracklines for all observed vessel transits that entered the breakwater from 1 January to 1 July 2022; the lines are color coded by the vessel type broadcast in the AIS message. AIS messages include vessel characteristics, including name and identification number, that are programmed by the operator and other data based on vessel actions. This makes it possible to parse the data based on characteristics of interest, on factors such as speed or heading, or according to derived calculations such as dwell or travel time. In Figure 1, the predominant trackline color is pink; this color represents fishing-type vessels (as self-identified by the vessel operator), and its predominance reflects the high level of fishing-vessel activity relative to other vessel types. There is an active commercial fishing industry at Newport, Oregon. In 2021, the local fishery landed 112.6 million pounds of seafood, worth an estimated $74.2 million (NOAA 2022).

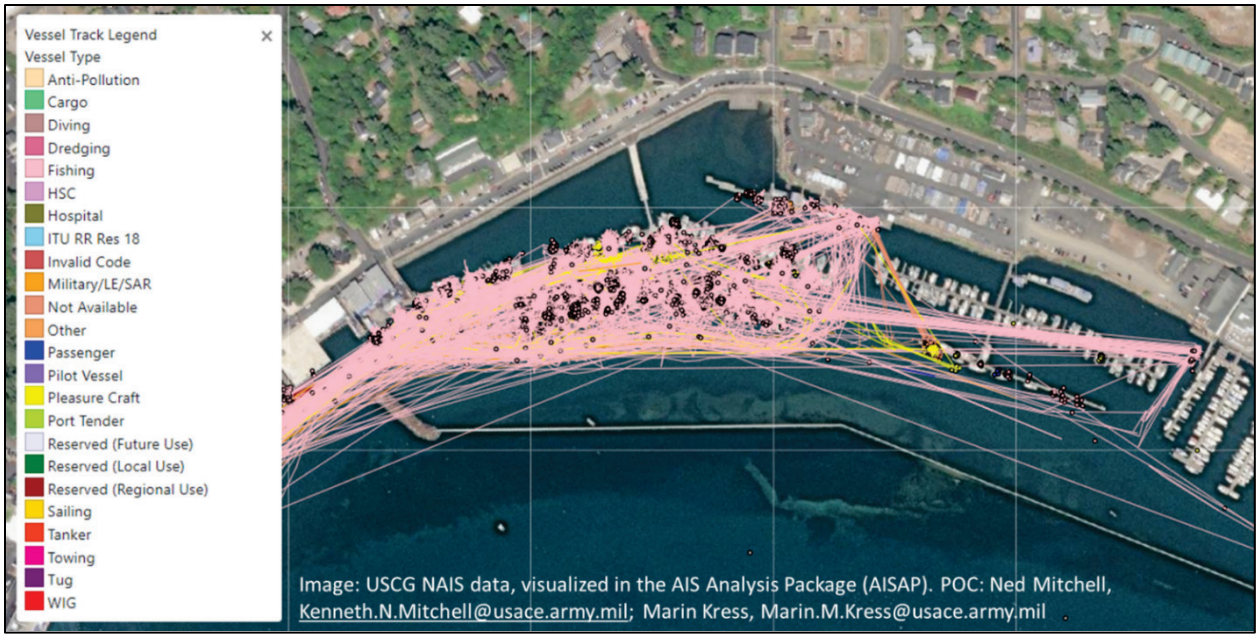

Figure 1. Vessel tracklines in the Newport, Oregon, commercial marina from 1 January to 1 July 2022. Tracklines are color coded by the vessel type listed in the Automatic Identification System (AIS) message. AIS data visualized in the Automatic Identification System Analysis Package AISAP (USACE-ERDC 2018).

METHOD: All available time-stamped and georeferenced vessel position AIS data were acquired from the USCG Nationwide Automatic Identification System (NAIS) archive for the period 1 January 2019 through 1 July 2022. The AIS records were uploaded into the AISAP software (USACE-ERDC 2018) for examination. Within AISAP, multiple areas of interest (AOIs) were created by drawing polygons that served as geospatial filters; these are shown as dark gray shapes in Figure 2. Multiple AOIs were needed to distinguish inbound from outbound vessel transits through either breakwater opening and to identify the timing of specific transit segments (e.g., how long it took to move from an area just outside the breakwater to a berthing area inside the breakwater). Additional filters based on vessel characteristics (e.g., length of 80 feet or greater) and direction of travel were applied to selected AOIs to examine subsets of the vessel traffic in the area designated as the commercial marina in Newport, Oregon (Port of Newport, n.d.). This included multiple docks inside the breakwater.

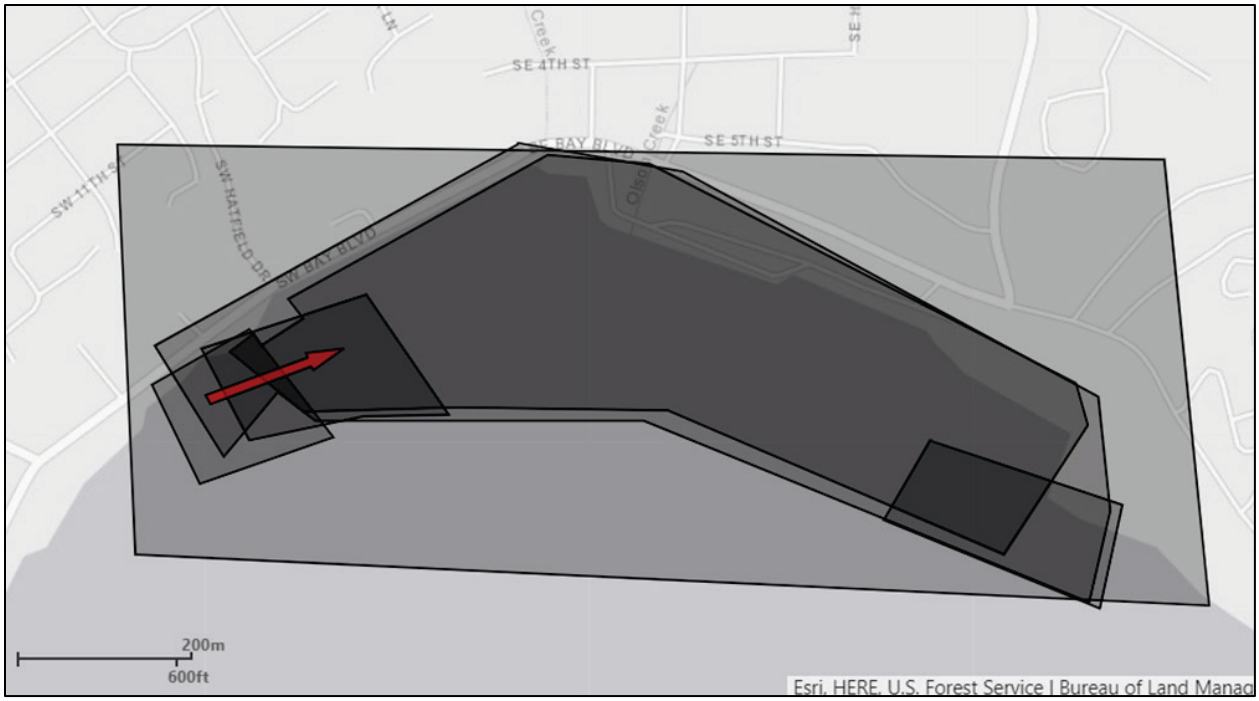

Figure 2. AISAP screenshot showing area of interest (AOI) polygons in *gray*. Each polygon is a separate geospatial and temporal filter that produces unique results in conjunction with any other filters the user may apply (e.g., direction, date range, vessel characteristics). The *red arrow* indicates the west entrance of the breakwater.

RESULTS: Initial results showed that very few vessels used the east entrance to the breakwater, so the remainder of the analysis of vessel traffic focused on movements through the west entrance of the breakwater (designated by the red arrow in Figure 2). Based on the Maritime Mobile Service Identity (MMSI) numbers broadcast in AIS messages, 181 unique vessels were observed during the study period. Figure 3 shows the distribution of vessels based on the length broadcast in each vessel's AIS message. Of the 181 vessels observed during the study period, 23 were broadcasting a vessel length of 80 feet or greater in their AIS message, but only 16 were observed making valid transits through the west breakwater entrance. Transits through the west breakwater entrance were defined as valid if the vessel transit followed a route from an area outside of the breakwater to an area inside of the breakwater (i.e., the vessel passed through the entrance) and did so within 10 minutes. Any transits with a longer transit time were considered invalid and were discarded.

There were no vessels measuring exactly 80 feet in the dataset; the shortest vessel above the 80-foot cutoff was listed as measuring 82 feet. Table 1 lists the name, MMSI, length, and the valid observed transit count for each vessel broadcasting a length of 80 feet or greater during the study period. The transits by vessels with lengths of 80 feet or more followed a seasonal trend, with more transits in the spring and summer months (roughly May–September) and very few or none in the winter months (Figure 4). Though doing so is a violation of USCG guidelines for AIS message encoding, many vessels broadcast a length of 0 feet.

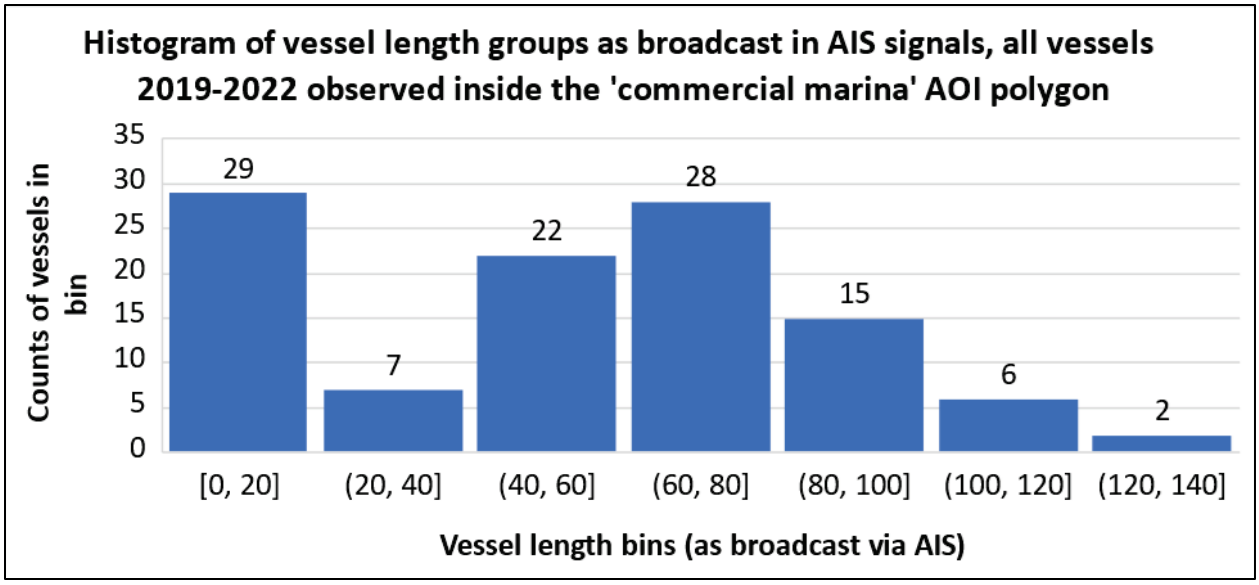

Figure 3. Histogram of vessel lengths observed during the study period. The starting parenthesis indicates the bin is exclusive of the first number listed, and the closing square bracket indicates the bin is inclusive of the second number. The opening square bracket under the first bin indicates that vessels broadcasting a length of zero are included in the bin. There were no vessels measuring 80 feet in the data; the shortest vessel above the cutoff measured 82 feet.

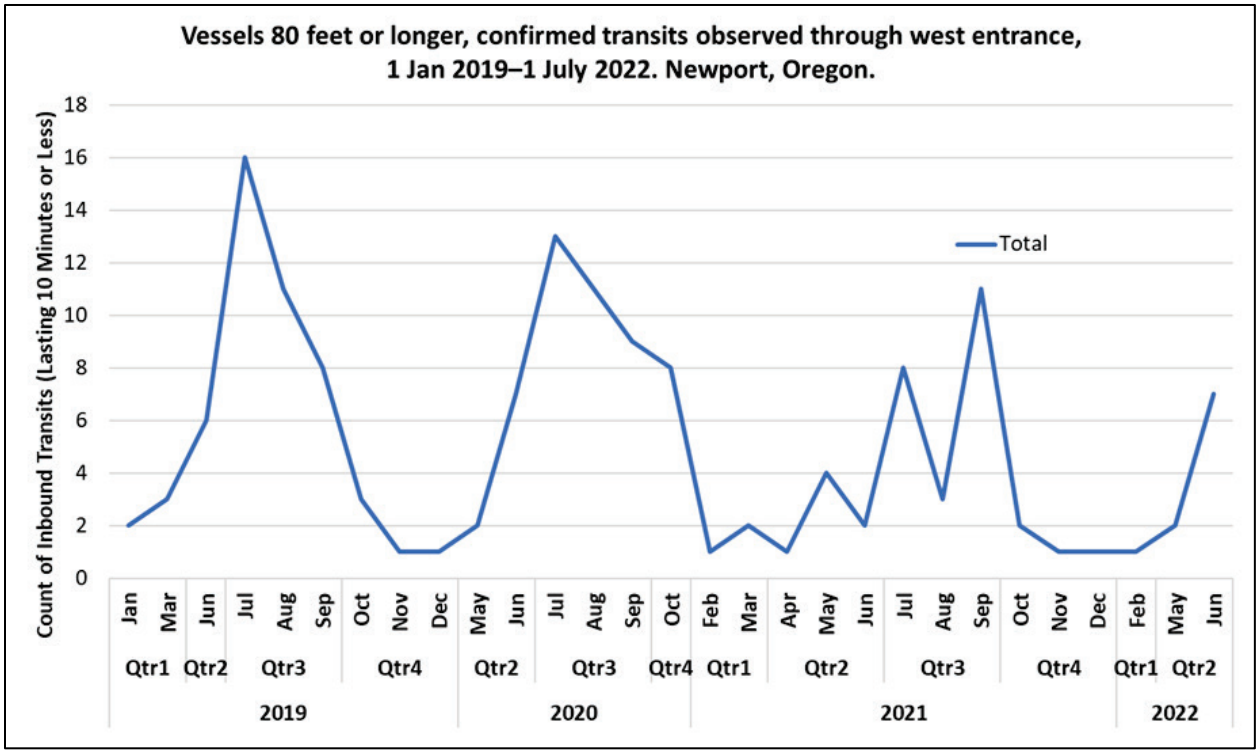

Figure 4. Confirmed transits by vessels of 80 feet or longer through the west breakwater entrance, 1 January 2019 through 1 July 2022, Newport, Oregon. Only months with observed transits are shown in the figure.

Table 1. Vessels over 80 feet in length and their observed inbound transits during the study period (1 January 2019–1 July 2022).

Vessel name in AIS message	Vessel length (feet) from AIS message	Observed inbound transit count	MMSI
LAST.STRAW	134.5	42	366245070
LESLIE LEE	114.8	2	338603000
PACIFIC RAM	114.8	8	338494100
MISS_SARAH	108.3	2	368206000
RAVEN	108.3	2	367774000
SHELLFISH	101.7	3	366950140
TABITHA	101.7	4	368094990
R/V CORAL SEA	98.4	1	368156000
BUCCANEER	98.4	1	367394090
DUSK	98.4	12	366744320
LADY LAW	91.9	2	367084010
MISS BERDIE	91.9	61	367341970
CG BLUE SHARK	85.3	1	366999636
MIKETTE	85.3	1	367323610
ZEPHYR	82	3	338142000
COAST PRIDE3333	82	2	367356180

Note. Inbound transits were confirmed based on AIS data showing vessel in an AOI just *outside* the breakwater followed by the same vessel being present in an AOI located *inside* the breakwater within 10 minutes. This was done to eliminate "ghost" transits that can be caused by the GPS signals bouncing off nearby metal structures, resulting in stray AIS position reports.

Figure 5 shows the re-created tracklines for vessels 80 feet or greater in length during calendar year 2021. The largest vessels tended to utilize the western part of the commercial marina. Figure 6 shows the tracklines for a single large vessel (i.e., MMSI 366245070) observed during 2021. The vessel primarily, but not exclusively, used the western half of the area inside the breakwater. This information may be useful when designing a potential federal channel inside the breakwater.

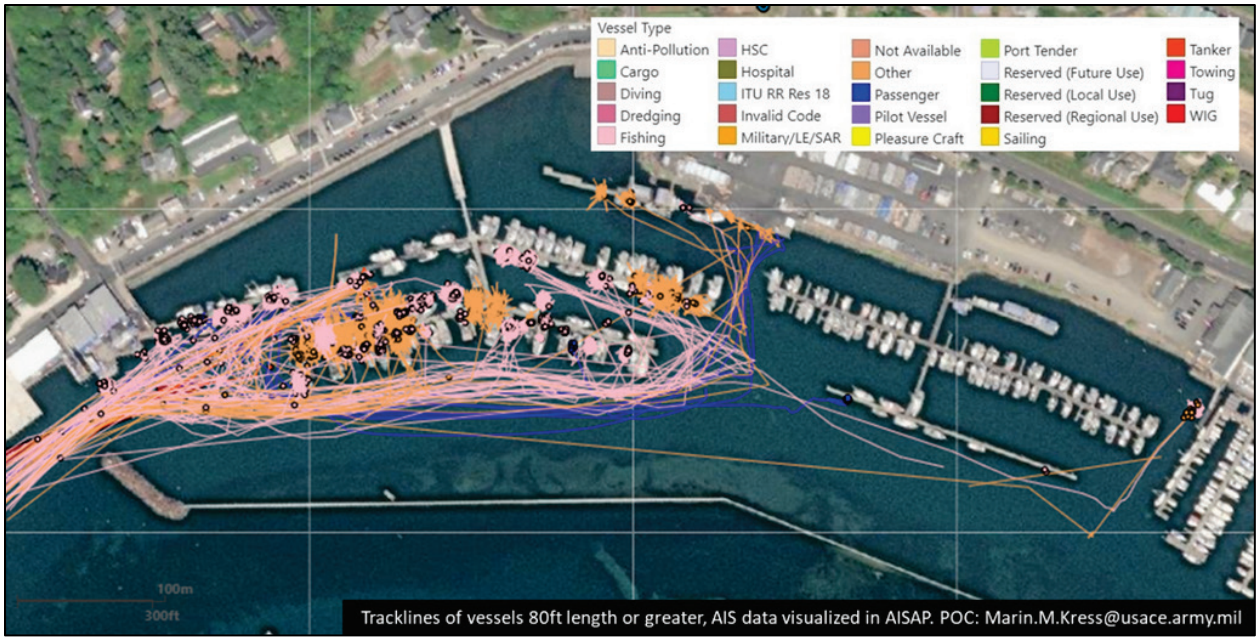

Figure 5. AIS tracklines color coded by vessel type for vessels 80 feet or greater in length during 2021. Common vessel types included fishing (*pink*), passenger (*dark blue*), and other (*orange*). AIS data visualized in AISAP (USACE-ERDC 2018).

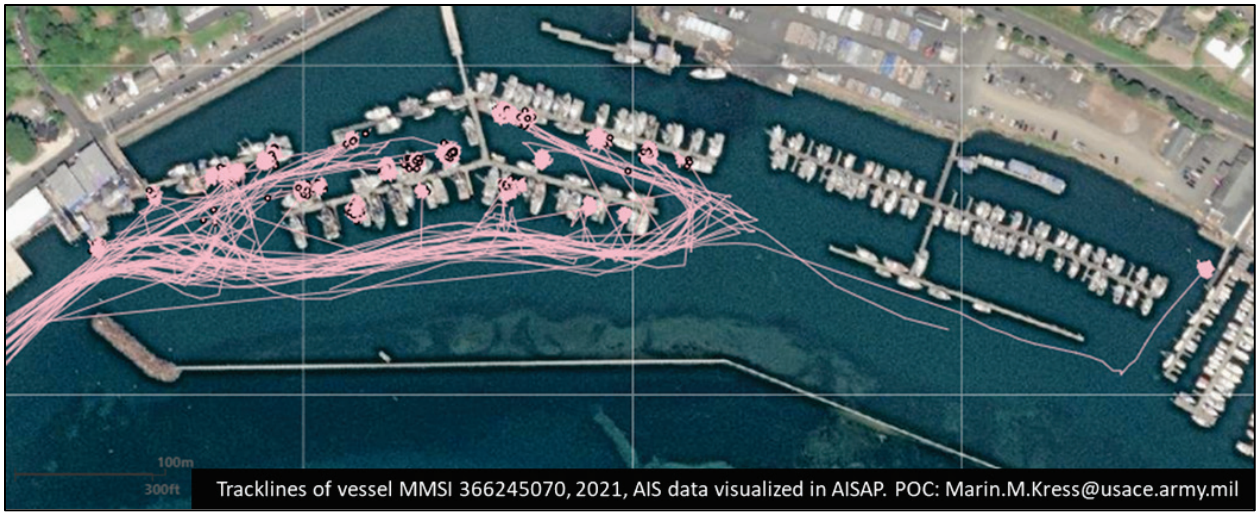

Figure 6. AIS tracklines of a single vessel (as identified by the MMSI) in 2021. AIS data visualized in AISAP (USACE-ERDC 2018).

SUMMARY: AIS data have been used previously to evaluate how vessels are using waterways (Kress et al. 2020) or benefitting from the presence of structures such as breakwaters or jetties (Scully et al. 2020; Young and Scully 2018). This project provides another example of how AIS data can be used to understand how vessels are maneuvering near an existing structure in an area where changes to an existing channel, or designation of an official channel, are being considered.

ACKNOWLEDGMENTS: Special thanks to the USCG Navigation Center (NAVCEN) for providing AIS data, to the NWP staff for collaborating on this project, and to the AISAP technical team. Thanks to the peer reviewers for their attention and suggestions on this document.

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> Kress, M. M. 2023. *AIS Data Case Study: Vessel Traffic through the Yaquina Bay Breakwater at Newport, Oregon.* ERDC/TN-DOTS-23-1. Vicksburg, MS: US Army Engineer Research and Development Center. *http://dx.doi.org/10.21079/11681/46549*.

REFERENCES

IALA (International Association of Marine Aids to Navigation and Lighthouse Authorities). 2008. *Establishment of AIS as an Aid to Navigation*. Report ID G1062. Saint Germain en Laye, France: IALA. *https://www.iala-aism.org/product/establishment-of-ais-as-an-aid-to-navigation-1062/*.

IEC (International Electrotechnical Commission). 2001. *Maritime Navigation and Radiocommunication Equipment and Systems—Automatic Identification Systems (AIS)—Part 2: Class A Shipborne Equipment of the Universal Automatic Identification System (AIS)— Operational and Performance Requirements, Methods of Test and Required Test Results*. EC 61993-2: 2001-12. Geneva, Switzerland: IEC.

ITU-R (International Telecommunications Union–Radiocommunication Sector). 2014. *Technical Characteristics for an Automatic Identification System Using Time Division Multiple Access in the VHF Maritime Mobile Frequency Band*. Recommendation ITU-R M.1371. Geneva, Switzerland: ITU. *https://www.itu.int/rec/R-REC-M.1371/en*.

Kress, M., B. Tetreault, K. Mitchell, M. Balazik, and M. Booton. 2020. *AIS Data: Real-Time Operation Support, Incident Investigations, and Waterway Use Analysis*. ERDC/CHL CHETN-IX-53. Vicksburg, MS: US Army Corps of Engineers. *https://doi.org/10.21079/11681/36395*.

NOAA. 2022. "NOAA Fisheries: Top U.S. Ports Database." Accessed September 29, 2022. *https://www.fisheries.noaa.gov/foss/f?p=215:11:5457150533611:::::*.

PIANC (The World Association for Waterborne Transport Infrastructure). 2019. *Guidelines and Recommendations for River Information Services*. InCom Working Group Report No. 125/I-2019. Brussels, Belgium: PIANC. *https://www.pianc.org/publications/inland-navigation-commission/wg125-1*.

Port of Newport. n.d. "Port of Newport: Commercial Marina." Accessed September 29, 2022. *https://www.portofnewport.com/commercial-marina*.

Scully, B., D. Young, and J. Ross. 2020. "Mining Marine Vessel AIS Data to Inform Coastal Structure Management." *Journal of Waterway, Port, Coastal, and Ocean Engineering* 146 (2): 04019042. https://doi.org/10.1061/(ASCE)WW.1943-5460.0000550.

USACE-ERDC (US Army Corps of Engineers, Engineer Research and Development Center). 2018. *AIS Analysis Package (AISAP)*. Software package. Vicksburg, MS: Engineer Research and Development Center. https://aisap.usacegis.us/aisap_portal/home.html.

US CFR (US Code of Federal Regulations). 2019. *Title 33–Navigation and Navigable Waters*. "Part 164–Navigation Safety Regulations." 33 C.F.R. § 164.46. Washington, DC. https://www.govinfo.gov/content/pkg/CFR-2019-title33-vol2/xml/CFR-2019-title33-vol2-part164.xml.

USCG (US Coast Guard). n.d. "Navigation Center: Automatic Identification System Overview." Accessed September 29, 2022. https://www.navcen.uscg.gov/automatic-identification-system-overview.

Young, D., and B. Scully. 2018. "Assessing Structure Sheltering via Statistical Analysis of AIS Data." *Journal of Waterway, Port, Coastal, and Ocean Engineering* 144 (3): 04018002. https://doi.org/10.1061/(ASCE)WW.1943-5460.0000445.