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AIS Data Case Study: Dredge Material Placement Site Evaluation in Frederick Sound near Petersburg, Alaska

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PURPOSE: The purpose of this Coastal and Hydraulics Laboratory Technical Note (CHETN) is to present an application of historic vessel position information acquired through the Automatic Identification System (AIS), which provides geo-referenced and time-stamped vessel position information. The US Army Corps of Engineers, Alaska District (POA), needed to evaluate potential placement sites for dredged material near Petersburg, AK, and possible impacts to navigation were considered as part of the evaluation process.

INTRODUCTION: The Petersburg, AK, South Harbor was developed in the early 1980s and is primarily used for commercial, recreational, and subsistence fishing. At the time of development, harbor depths ranged from -15 ft[1,2] to -18 ft Mean Lower Low Water (MLLW) (POA 2020). Dredging is needed to allow safe access and usage of floating dock and ramp facilities across the full tidal range in Petersburg South Harbor. Areas identified for dredging in the harbor included the entrance channel, maneuvering basin, and two turning basins (POA 2020). However, since previous dredging activities last occurred in 2002, a new placement site for dredged material had to be identified. Potential locations for a new dredged material placement site were identified through a comprehensive "Zone of Siting Feasibility" (ZSF) evaluation process conducted by POA. The analysis was conducted under the authority provided in Section 103(e) of the Marine Protection, Research and Sanctuaries Act (MPRSA, also known as the Ocean Dumping Act), 33 United States Code (USC) 1413(e), (33 C.F.R. § 1401-1445).

The factors that were considered in the ZSF evaluation included the following:

- Costs of transportation to the disposal site and costs of the navigation project
- Type of dredging and disposal plant
- Navigation restrictions
- Distance to the edge of the continental shelf
- Political and other jurisdictional boundaries
- Feasibility of monitoring and surveillance
- Potential impacts on fishing, shellfishing, fish and shellfish culture, habitat functions (e.g., spawning, passage, nursery, and feeding activities), shipping, recreation, mineral extraction, desalination, scientific research, or cultural resources.

[1] For a full list of the spelled-out forms of the units of measure used in this document, please refer to *US Government Publishing Office Style Manual*, 31st ed. (Washington, DC: US Government Publishing Office 2016), 248-52, https://www.govinfo.gov/content/pkg/GPO-STYLEMANUAL-2016/pdf/GPO-STYLEMANUAL-2016.pdf.

[2] For a full list of the unit conversions used in this document, please refer to *US Government Publishing Office Style Manual*, 31st ed. (Washington, DC: US Government Publishing Office 2016), 345-7, https://www.govinfo.gov/content/pkg/GPO-STYLEMANUAL-2016/pdf/GPO-STYLEMANUAL-2016.pdf.

This CHETN focuses on the portion of the ZSF evaluation that examined vessel activity. For additional details on the evaluation process as completed to comply with the Ocean Dumping Act criteria, readers are referred to the report *Ocean Dumping Act Criteria: Frederick Sound Disposal Site near Petersburg, Alaska* (POA 2020).

METHODS: An initial ZSF near Petersburg, AK, was created by drawing a radius of three nautical miles (NM) around the Petersburg South Harbor and then removing all areas with water less than 18 ft deep (MLLW) (POA 2020). This area is shown in green in Figure 1.

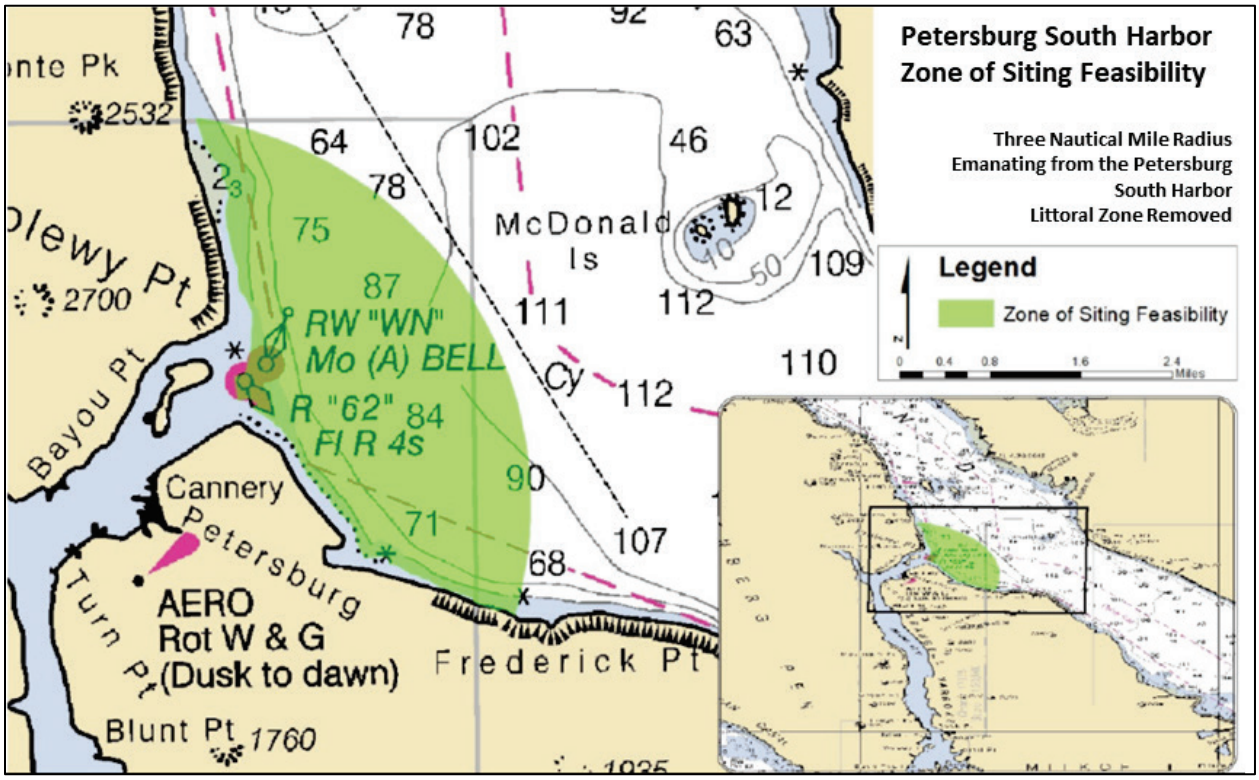

Figure 1. ZSF established by creating a 3 NM radius around the Petersburg South Harbor and removing all water less than 18 ft deep. Source: Redrawn from Figure 5 in POA (2020).

AIS data from the US Coast Guard (USCG) Nationwide Automatic Identification System (NAIS) archive (USCG 2018) was requested for the period of October 1, 2018, through December 31, 2018. The data request was made using web services provided by the AIS Analysis Package (AISAP) software (USACE-ERDC 2018). This time period was selected to correspond with the beginning of the potential dredging work window in Petersburg, which will start on October 1 of the construction year. AIS records from this time showed 721 unique vessels present in the general area. Of those 721 vessels, 277 self-identified as Fishing-type in their AIS broadcast. There were also 225 Pleasure Craft; 68 Sailing; 28 Passenger; 33 Not Available; 20 Towing; 7 Tug; 4 Cargo; with low numbers in other AIS vessel-type categories. AIS signals from vessels at anchor inside Petersburg Harbor were removed from the analysis to focus only on transiting vessels (POA 2020). A signal density map (*heat map*) of the vessel position reports was then plotted over the ZSF. This is shown in Figure 2 (orange colors correspond to a higher density of vessel position reports).

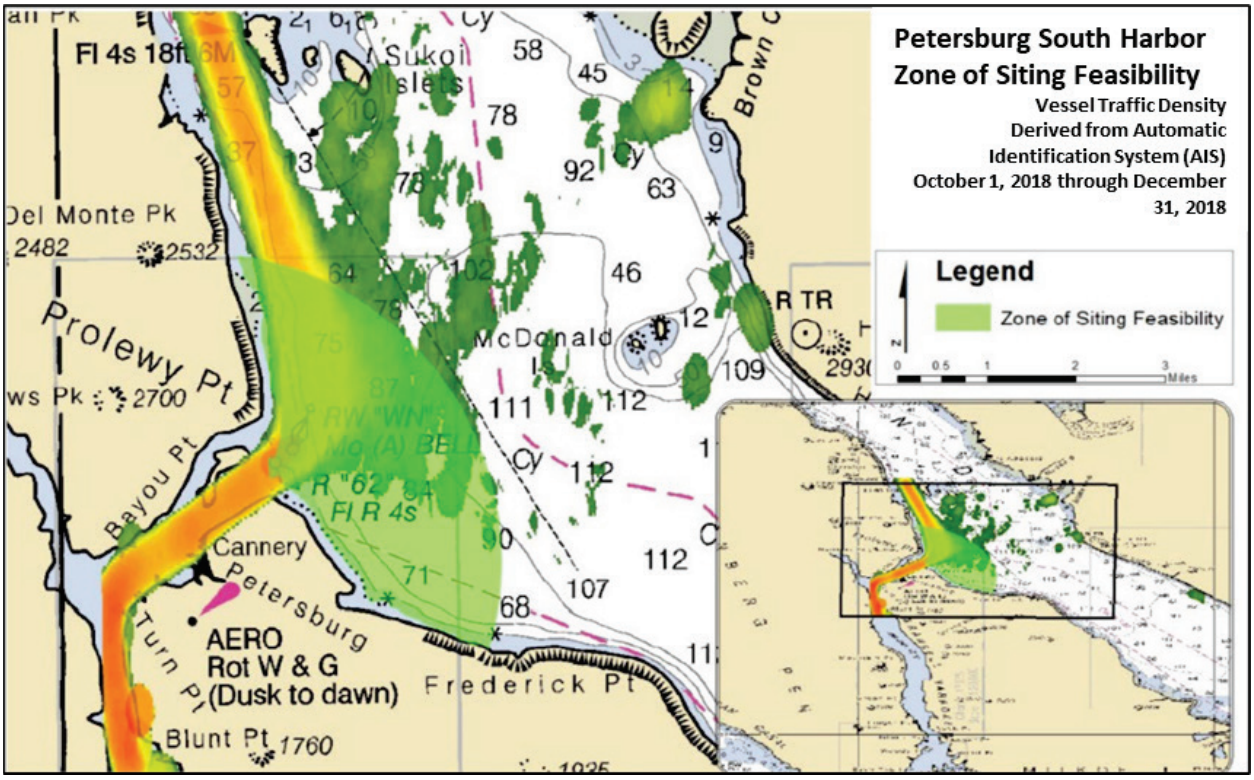

Figure 2. ZSF (bright green fan-shaped area) with AIS signal density map (heat map) representing vessel traffic. Orange colors correspond to higher AIS signal density; dark green to lower signal density. Source: Redrawn from Figure 6 in POA (2020).

Based on records of previous dredged material placement, POA conducted ecological sampling within three defined polygons inside the ZSF to describe the benthos, understand seasonal variability in epibenthic population distribution, determine physical consistency between dredged material and the native substrate, and examine potential impacts to epibenthic fauna (POA 2020). The three defined polygons used for ecological sampling are shown in Figure 3 as blue, red, and yellow rectangles overlaid with the same vessel traffic heat map introduced in Figure 2.

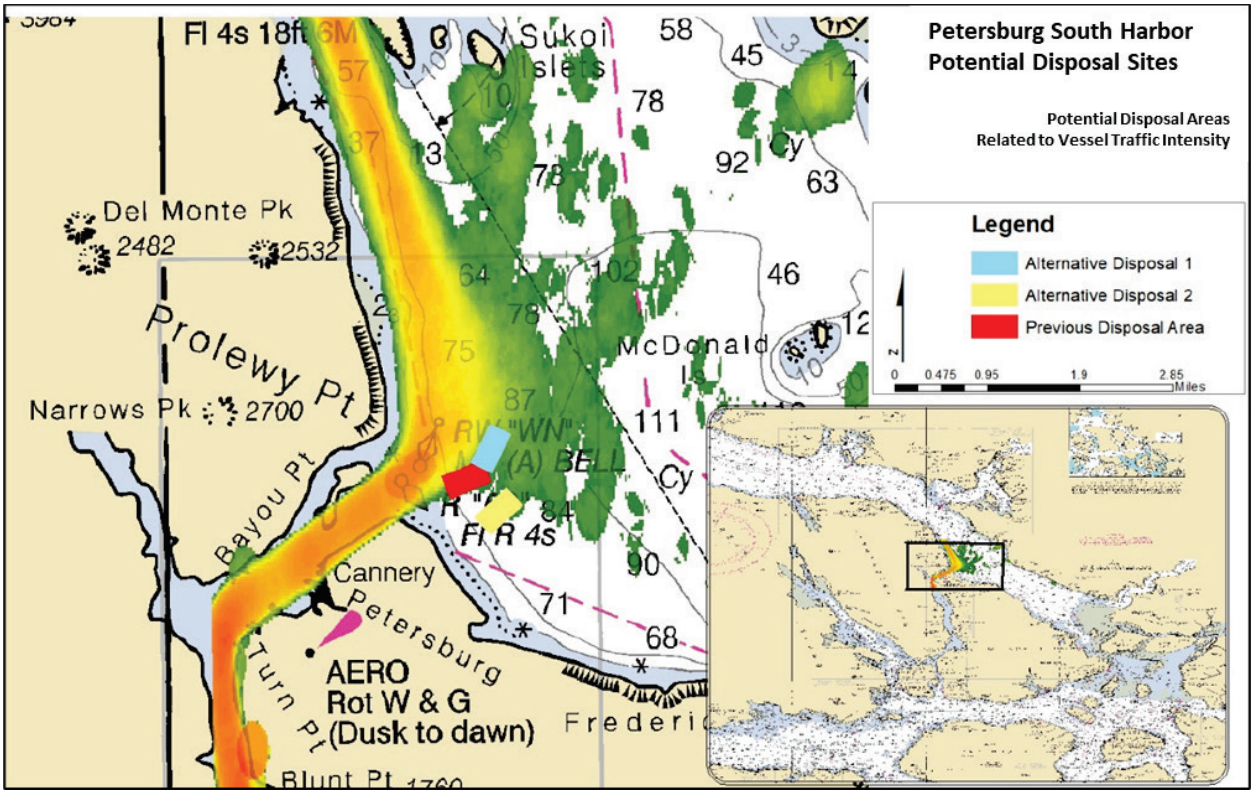

Figure 3. Potential Frederick Sound disposal sites in relationship to vessel traffic heat map. Source: Redrawn from Figure 13 in POA (2020).

RESULTS: Based on the suite of site consideration criteria as described in the full report, a placement area for dredge material for the Petersburg South Harbor dredging project was selected by POA, and the US Environmental Protection Agency concurrence was received on April 14, 2021 (POA 2020). The area initially labeled as "Alternative Disposal 1" in Figure 3 was selected as the future placement site for dredged material; it was subsequently given the title of "Frederick Sound Disposal Site (FSDS)." The FSDS is defined as a 75-acre rectangle on the seafloor, centered on latitude 56.832202 and longitude -132.911592. This designation was based on an extensive evaluation that included potential impacts to navigation activities. Based on maps of historic vessel traffic as recorded by AIS, vessels approaching or departing Wrangell Narrows generally avoid the FSDS, although there is minimal vessel traffic in the general area, as shown in the heat map in Figure 3 (POA 2020). Commercial fishing activities occur in the vicinity of the proposed placement area, but local stakeholders confirmed that fishing activities within the proposed placement area boundaries are so infrequent that they are assumed nonexistent (POA 2020). When any future dredging activities do occur, there is a plan for frequent marine communication between the dredging vessels and disposal tugs and the Petersburg Harbormaster to avoid conflicts with shipping activities. The FSDS is expected to receive material only from the Petersburg South Harbor Navigation Improvement Project and will be subject to preconstruction surveys of the bathymetry, sediment quality, and epibenthic community composition to establish an environmental baseline (POA 2020).

ADDITIONAL INFORMATION: This CHETN was prepared by Matthew Ferguson, *Matthew.W.Ferguson@usace.army.mil*, POA, and Dr. Marin M. Kress, *Marin.M.Kress@usace.army.mil*, ERDC Coastal and Hydraulics Laboratory (ORCiD *https://orcid.org/0000-0002-5835-5686*), US Army Engineer Research and Development Center. Special gratitude is extended to the USCG NAIS program; Dr. K. N. Mitchell, AISAP technical lead; and reviewers of this document. This CHETN was funded by the USACE Navigation Systems Research Program and should be cited as follows:

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