VENTURA
PORT DISTRICT
Established 1952

BOARD OF PORT COMMISSIONERS

JULY 1, 2020

STANDARD AGENDA ITEM 1

DRAFT NAVIGATION RISK ASSESSMENT FOR THE PROPOSED VENTURA SHELLFISH ENTERPRISE PROJECT

VENTURA PORT DISTRICT **STANDARD AGENDA ITEM 1**
BOARD COMMUNICATION Meeting Date: July 1, 2020

TO:	Board of Port Commissioners
FROM:	Brian D. Pendleton, General Manager
SUBJECT:	Draft Navigation Risk Assessment for the Proposed Ventura Shellfish Enterprise Project

RECOMMENDATION:
That the Board of Port Commissioners receive an informational report on the draft Navigation Risk Assessment for the proposed aquaculture project referred to as the Ventura Shellfish Enterprise (VSE).

SUMMARY:
The Ventura Port District (Port District) filed an application with the U.S. Army Corps of Engineers (Corps) for a permit to establish an aquaculture farm in federal waters near Ventura Harbor (Blocks 664 and 665). In response to the Corps' public notice concerning the project, the U.S. Coast Guard (USCG) requested preparation of a Navigation Risk Assessment. As a result, the Corps required the Port District to prepare and submit a Navigation Risk Assessment.

It is the goal of this meeting to present the draft Navigation Risk Assessment prepared by consultant COWI on the Port District's behalf, receive and consider stakeholder comment, and return to the July 15, 2020 meeting with the final Navigation Risk Assessment for submission to the Corps and USCG.

BACKGROUND:
The Port District submitted the permit application to the Corps and application for a Coastal Consistency Determination to the California Coastal Commission (Coastal Commission) in October 2018. The project's origins, goals and project funding are extensively discussed in a project status report to the Board on July 17, 2019.

Since receiving the permit application, the Corps conducted its required public comment process, and received comments from the USCG and the Ventura Local Agency Formation Commission (LAFCo). On January 15, 2020, the Corps sent a letter to the Port District requesting a Navigation Risk Assessment, as requested by the USCG, and resolution of a jurisdictional issue raised in the LAFCo letter. As stated in the Corps' letter: "If the requested information cannot be submitted within 30 days, the Corps will withdraw your permit application. When you do provide the requested information, the Corps will resume review of your previously submitted permit application." On February 18, 2020, the Corps notified the Port District that its application had been administratively withdrawn, again stating that it would resume processing the application once the Port District provides the information requested in the January 15 letter. The Port District is working cooperatively with the Ventura LAFCo to resolve their differences and an update on this issue will be discussed in a separate project status report to the Board.

COWI prepared the Navigation Risk Assessment in a manner that took into consideration the unique aspects of the planned aquaculture project, while also ensuring that the Navigation Risk Assessment remains independent and impartial. The approach to this study is as follows:

- Provide a review of USCG procedures for studying navigation risk, and provide a basis for the scope of this study;

- Provide information on the vessel type and waterway use near the proposed aquaculture locations, including;
    - Type, size and drafts of vessel;
    - Vessel routes;
    - Traffic density;
    - Seasonal vessel traffic variances;
    - Notable marine events;
- Present waterway characteristics, including prevailing weather conditions and bathymetry;
- Discuss the risk of collision as a result of the aquaculture project, including;
    - Likelihood of collision between vessel and aquaculture;
    - Likelihood of vessels propeller/rudder getting entangled in 'non-fixed' aquaculture lines;
    - Increased likelihood of collision between vessels;
- Discuss additional navigation considerations such as:
    - Increased waterway constraints;
    - Impact on vessel anchoring;
    - Effects of aquaculture on vessel radar and communications;
    - Marine navigational markings;
- Review the consequences of collision, both on the vessel and the aquaculture;
- Discuss potential mitigation measures, if required.

COWI performed this analysis based upon objective and verifiable data from the National Ocean and Atmospheric Administration, the California Department of Fish and Wildlife, the Ventura Port Harbormaster, and USCG. The draft report concludes that “upon incorporation of project design features, all the identified and realistic risks as a result of the project were already mitigated to a level where the risk were low or negligible.” However, the report identifies some additional low-cost mitigation measures that could further reduce the risk of collision or accident.

FISCAL IMPACT:
On March 4, 2020 the Board approved a contract with COWI to prepare the Navigation Risk Assessment in the amount of $64,040.

ATTACHMENTS:
Attachment 1 - COWI Navigation Risk Assessment
Attachment 2 - Corps letter(s), dated January 15, 2020 and February 18, 2020

ATTACHMENT 1

JUNE 2020
VENTURA PORT DISTRICT

AQUACULTURE NAVIGATION RISK ASSESSMENT

VENTURA SHELLFISH ENTERPRISE, VENTURA, CA

PREPARED FOR:

VENTURA PORT DISTRICT
Established 1952

PREPARED BY:

COWI

COWI

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ATTACHMENT 1

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JUNE 2020
VENTURA PORT DISTRICT

NAVIGATION RISK ASSESSMENT

VENTURA SHELLFISH ENTERPRISE, VENTURA, CA

PREPARED FOR:

VENTURA PORT DISTRICT
Established 1952

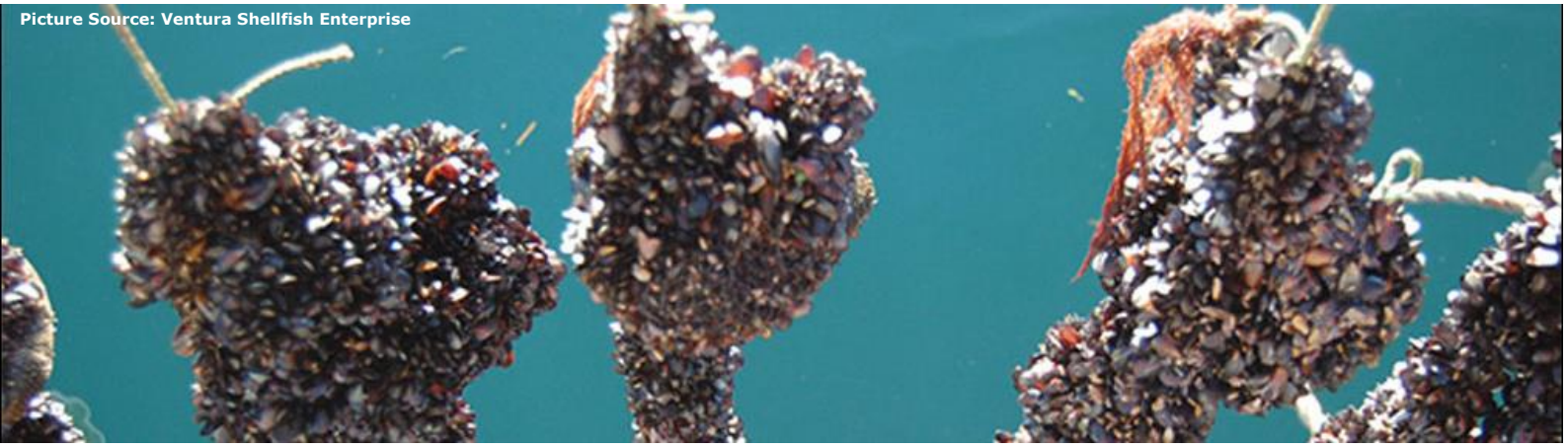
PREPARED BY:

COWI

PROJECT NO.	DOCUMENT NO.
A133628	001

VERSION	DATE OF ISSUE	DESCRIPTION	PREPARED	CHECKED	APPROVED
001	06/25/2020	Draft Report	MGNN	CHTM, IBK	CHTM

ATTACHMENT 1


Picture Source: Ventura Shellfish Enterprise

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1 Executive Summary

A Navigation Safety Risk Assessment has been conducted for the Ventura Shellfish Enterprise (VSE) Aquaculture Farm project. The planned aquaculture farm, located approximately 3.5 nautical miles from the shore, will be near Ventura Harbor with all regular service and support vessels expected to be located within the harbor.

The navigation risk assessment identifies navigation risks associated with the project, evaluates those risks and provides suggestions and recommendations for additional mitigation measures if deemed necessary. It serves as a key decision support document in the process of determining if the navigation risk associated with the project is acceptable and if navigation safety will be maintained after the installation of the aquaculture farm.

The navigation risk assessment includes vessel and environmental data from a number of sources, including 2017 AIS data; commercial and recreational fishing data from the California Department of Fish and Wildlife (CDFW); vessel traffic patterns and detailed information about vessel size, draft etc., from the National Oceanic and Atmospheric (NOAA); and information from the Ventura Harbor Harbormaster and environmental conditions such as wind, current, visibility.

A number of risks were identified within the three main categories:

1 Vessel entanglement during normal aquaculture farm operation
2 Detached aquaculture elements/lines
3 Collision and grounding

Within each of these main categories, a number of different risk scenarios were identified. Each of the risks were subsequently evaluated qualitatively using information from the vessel traffic analysis and identified mitigation measures that have been incorporated into the project design by the project team.

Generally, the available data shows that the location of the aquaculture farm has limited impact to existing vessel traffic patterns, including commercial and recreational fishing. While the data shows that fishing occurs in the vicinity of the project area, there does not appear to be a high level of fishing activity and the project would not result in a significant increase in navigation risk related to fishing vessels.

One of the overarching identified risks was the potential for a local third-party vessel to become entangled with the farm equipment, with a potential worst-case scenario of capsizing of the vessel and casualties. As further described in the assessment, this risk has been adequately mitigated through the following measures:

- The farm will be marked on the navigation chart and all major equipment associated with the project, other than surface buoys and U.S. Coast Guard navigational and safety buoys, will be submerged at least 15ft below the waterline. The surface buoys will be in tension throughout all tidal and marine conditions and therefore no slack lines will be on the surface. The surface buoys will also provide visual identification of the area. No additional mooring equipment for services vessels is required at the aquaculture farm, and therefore no surface pick uplines will be required.
- The project permit design has been engineered to withstand 100-year storm conditions, thus minimizing the risk of broken lines or elements that would pose a risk of vessel entanglement.
- Sinking ropes will be used to connect to surface buoys as well as other elements that may be slack under certain conditions or not able to withstand a 100-year storm. Thus, in the event that any of these elements breaks loose during a storm or from an accidental impact, they will not float to the surface. Any sinking ropes that break loose will be retrieved as part of the project's gear maintenance program.

Operational procedures such as frequent maintenance and immediate repairs will also contribute to mitigate the risk of entanglement, and this will be a requirement of any commercial operator associated with the VSE project area.

The project also proposes speed restrictions for vessels near and within the project site to further reduce both the likelihood and consequence of vessel collisions. Although not currently proposed, an exclusion zone could be considered to prohibit third-party vessel traffic through the project site.

The assessment also considers the increased risk of vessel to vessel collisions resulting from harvest and maintenance vessels (project vessels) going to and from the farm and Ventura Harbor on a daily basis. It is expected that, for a fully developed project, 8-16 vessels servicing the project will travel to and from the project site daily. This is not considered to be a significant increase of the volume of traffic entering and leaving Ventura Harbor. In addition, project vessels will normally only operate during daylight when visibility is best. During transit to the farm from Ventura Harbor the amount of third-party vessel traffic crossing the navigation route is very limited, thus reducing the likelihood of vessel to vessel encounters with the potential for collision.

While the risk of collisions is considered low, it is still recommended that project vessels be equipped with AIS. In addition, the local maritime community should be informed about the project and the anticipated increase in vessel traffic.

2 Introduction

The Ventura Port District (VPD) has submitted an application to the U.S. Army Corps of Engineers (USACE) for an aquaculture project to grow Mediterranean mussels in federal waters off the Santa Barbara Channel, approximately 3.5 miles from the shore, northwest of Ventura Harbor (see Figure 2-1). The project will consist of 20 aquaculture plots, each 100 acres in size, for a total of 2,000 acres. All product harvested from the project site is proposed to be landed in Ventura Harbor, which is approximately 4 miles from the nearest aquaculture plot. The installation of the 2,000 acres will be phased such that 500 acres per year will be installed, on condition that the project meets certain environmental requirements as established by regulatory agencies as part of approval of project permits and monitoring plans.

During their review of VPD's application, USACE and U.S. Coast Guard (USCG) requested a formal Navigation Safety Risk Assessment (NSRA) to be completed as part of the Project's permit application review process to evaluate potential impacts to vessel safety. To comply with this request, VPD commissioned COWI to undertake this navigation risk assessment in line with recommended USCG procedures.

Figure 2-1 Location of VSE Aquaculture Project

2.1 Objective

The objective of this study is to identify, analyze and evaluate navigation risks and impacts associated with the VSE project. Navigation impacts to both commercial and recreational fishing, as well as other vessels, are considered. Based on the evaluated risk level, additional mitigation measures are proposed herein to reduce the navigation risk even further.

2.2 Scope and outline

This NSRA will consist of five Stages as outlined below:

- Stage 1: Vessel Traffic Analysis and Existing Environmental Conditions
- Stage 2: Hazard Identification
- Stage 3: Risk Evaluation
- Stage 4: Additional Mitigation Measures
- Stage 5: Public Review

Stage 1 includes a description the existing environmental conditions in the area near the project site, including wind, current, tidal conditions etc. Following this, the vessel traffic analysis identifies waterways and waterway characteristics together with vessel quantities, types and sizes.

Stage 2 includes identification of potential hazards based on the vessel traffic analysis, previous studies considering navigation risks related to this project, and general risks associated with vessel traffic and offshore installations. This stage includes identification and description of risk reducing measures and best management practices that have already been incorporated into the project plans.

In Stage 3 involves a qualitative or semi-quantitative evaluation of the risks to determine the risk level and discussion of the potential consequences.

Stage 4 involves identification of additional mitigation measures based upon the risk evaluation additional mitigation measures and discussion on how these measures will reduce the risk.

Finally, in Stage 5, The Navigation Risk Assessment will be shared for public review and comment. The results of the study will be presented at the VPD Board of Commissioners at a public meeting and relevant input and comments will be incorporated into the final Navigation Risk Assessment.

3 Site description

The VSE project is located in Southern California approximately 3.5 nm out from shore and 4 nm from Ventura Harbor. The project, at full build-out, will consist of 20 distinct farm plots of 100 acres each, organized in a grid as shown in Figure 3-1. The overall dimensions of the project site will be 1.5 nm x 1.5 nm. Each plot will be approximately 2300 ft long and 1900 ft wide and accommodate up to 24 long-lines in 12 rows. There will be a 50-foot separation distance at the end of each line between the screw anchors, and parallel lines will be spaced 150 feet apart. A 125-foot separation distance between the last line and the edge of the farm parcel will be required, giving a total of 250 feet between the lines of adjacent parcels. A navigation corridor, 600 ft wide, is located in the center of the farm to allow for individual access to each plot. The corridor is not designed for third party vessels unrelated to the project to transit through the site.

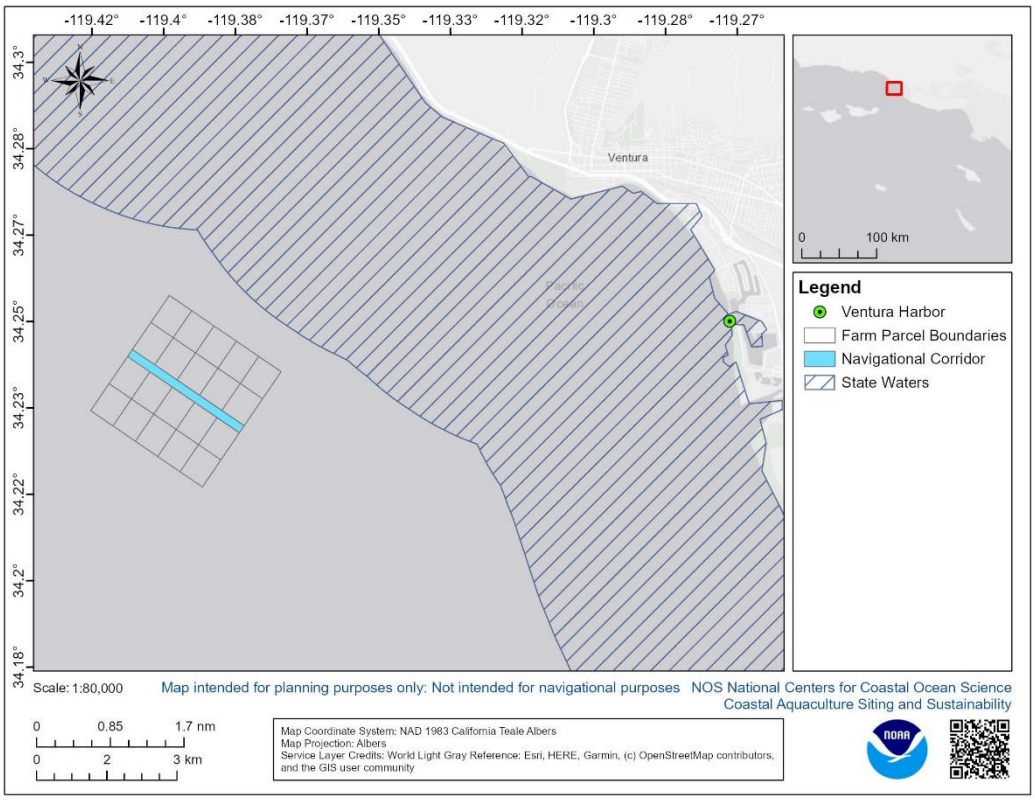

Figure 3-1 Aquaculture farm – grid structure

3.1 Aquaculture farm design principles

Figure 3-2 shows the proposed design of the longline array. The longlines will be submerged between 15-45 ft and anchored in each end using mooring lines and sand screw anchors. Based upon a permit level engineering analysis commissioned by VSE the mooring lines, longlines, and anchors have been designed to withstand a 100-year storm.

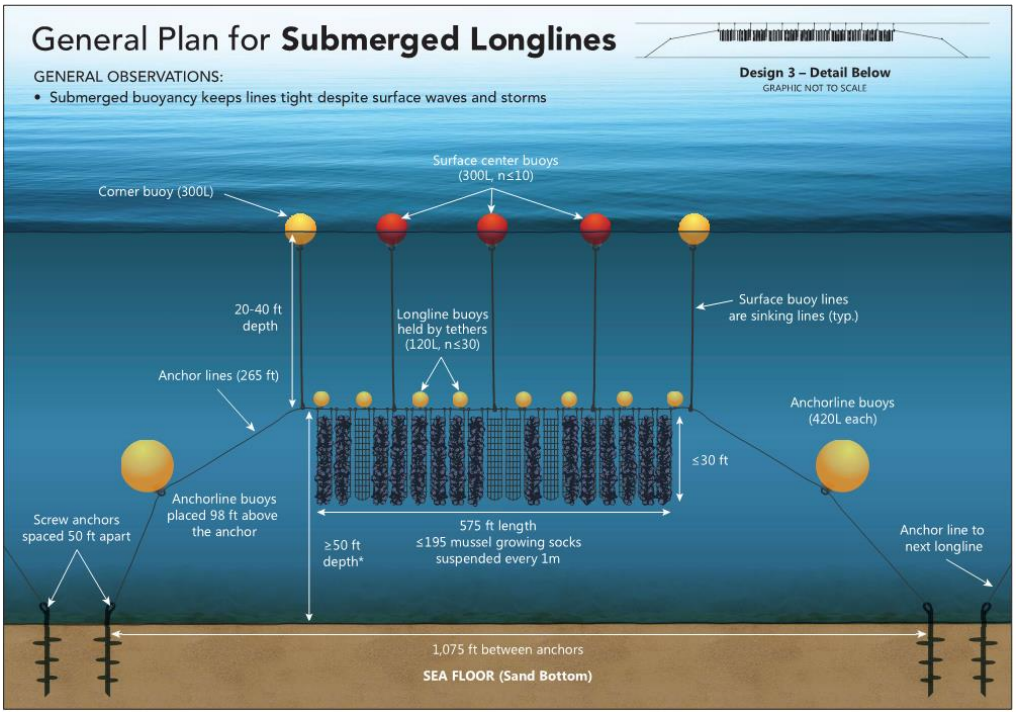

Figure 3-2 General plan for submerged longlines

Operators will be required to use sinking rope for any ropes or lines associated with the aquaculture system that have the potential to be slack under certain design storm conditions, thereby significantly reducing the risk of any slack lines being present on the water surface. Growers will be required to recover any broken or damaged ropes or lines as part of the project's gear maintenance program.

Submerged buoys will provide support and stability for the system. Surface buoys will mark each end of the longline. The surface buoys are designed to always be in tension. To further minimize entanglement potential, a 1,100 pound breakaway link will be installed between the surface buoys and vertical lines. The attachment line from the backbone to the surface buoy will be required to be made from sinking rope to ensure that the rope does not float on the surface in the event that a surface buoy becomes disconnected from its attachment line. Instead, it is intended that the rope should sink below the connection point with the longline and be at least 15 ft below the water surface.

Each individual farm plot will be marked by USCG-approved navigation marking in each corner with the appropriate lighting, radar reflectors, markings, AIS etc. As the project will be a phased development project, individual users will have to mark their own areas as part of the operational requirements.

3.2 Operation and Maintenance

While VPD will acquire and hold the permits for the VSE project, the operations will be conducted by different shellfish growers. For the purposes of this analysis, it is expected that growers will use regular maintenance and harvesting vessels 25-40 ft in length with fuel capacity of 100-500 gallons, and that all vessels operating in the project site will have a draft assumed to be less than 15 ft. This assumption is

based upon the Project teams understanding of the west coast aquaculture service vessel fleet and, although not a requirement of the operations manual, would mean there will be minimal risk of entanglement with the subsurface aquaculture equipment.

It is expected that 20-40 different vessels will operate to and from the farm. Because VPD will require all vessels to land product harvested from the project area be landed in Ventura Harbor, the assumption is that almost all, if not all, vessels will port in Ventura Harbor for efficiency. Further, this assumption provides a more conservative analysis, as it results in the most frequent and dense vessel traffic pattern to evaluate potential impacts, as compared to a different model wherein some vessels would travel to other ports. Vessels are expected to travel to the project site a few days per week with some variation.

For the purpose of the navigation risk assessment, which will consider a fully developed project site, it is estimated that there will be approximately 3,000-6,000 trips to and from the farm every year, corresponding to an average of 8-16 vessels going to and from the farm every day.

A gear maintenance plan has been incorporated into the project design, which will be require bi-monthly (twice per month) maintenance and inspection of longlines, anchor ropes, anchors, and connecting ropes. Any damage must be repaired immediately and reported to VPD and other relevant regulatory agencies. The VSE project also requires shellfish growers to submit a decommissioning plan in the event that their authorization expires or is terminated.

3.3 Ventura Harbor

Ventura Harbor is administered by the VPD and is under the control of a harbormaster [1]. It is a small-craft harbor primarily used by the pleasure craft and recreational and commercial fishing vessels. It has existing berthing facilities for about 1,500 boats. Commercial fish processing facilities, including fish landing docks and quayside services, are available in the Harbor. The entrance to Ventura Harbor is between two jetties protected by a 1,800-foot detached breakwater. The buoys in the entrance channel and harbor are frequently relocated due to changing conditions. Mariners that use Ventura Harbor are advised to exercise caution and to contact the harbormaster for the latest channel and Harbor conditions prior to entering.

4 Environmental conditions and vessel traffic analysis

The NOAA National Centers for Coastal Ocean Science (NCCOS) Coastal Aquaculture Siting and Sustainability (CASS) team has provided the input data used in this navigation risk assessment, including meteorological and oceanographic data, vessel traffic data, accident data and other relevant information, to inform the hazard identification and risk evaluation presented in Chapter 5[1].

4.1 Environmental conditions

Buoys, weather stations, and oceanographic models were examined and the best available or most representative data for each environmental variable was chosen as it relates to the VSE project site. Figure 4-1 displays the various locations that were used to extract existing environmental information. During evaluation of environmental variables, the proximity of the data's source location as compared to the location of the VSE site should be considered.

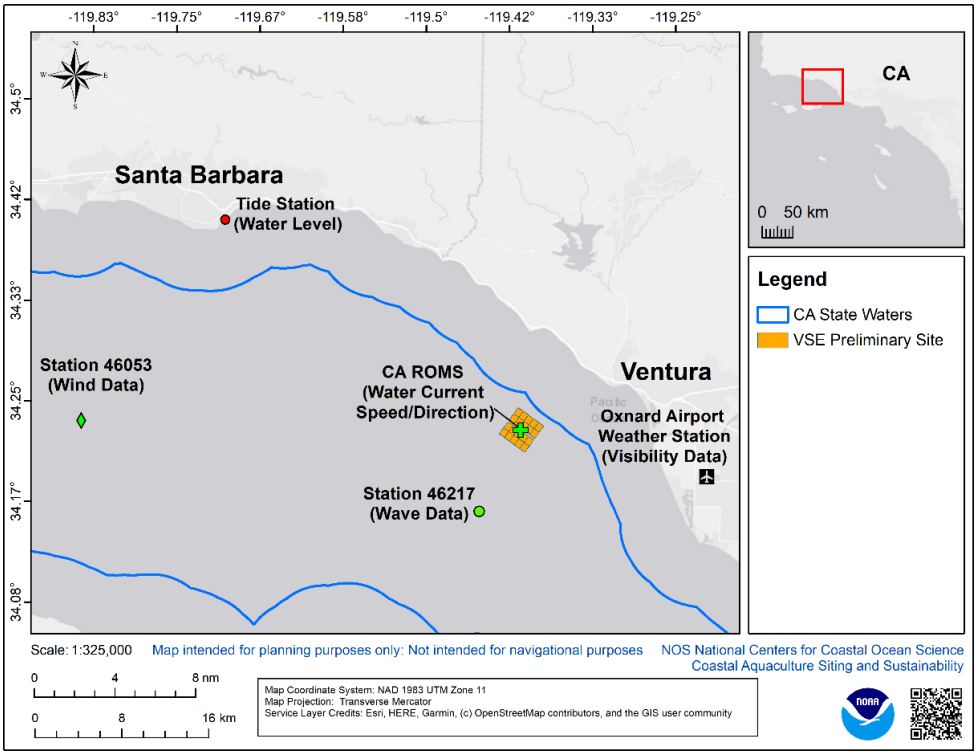

Figure 4-1 The VSE project site is shown with the locations of different data sets that were collected and used for the analysis.

4.1.1 Wind

The nearest available open ocean wind data located was located 20 nm west of the project site, from the East Santa Barbara Data Buoy (National Data Buoy Center

[1] NOAA NCCOS make no warranties to the accuracy or completeness of the data presented here, and NOAA will not be responsible for any adverse result based upon users' reliance on the application or the data presented. Users are advised to exercise due diligence and independently confirm the accuracy and currentness of the data provided.

(NDBC) Station 46053) [2]. Hourly wind data from 1994 to 2019 is summarized in a percent occurrence table by wind speed and direction, Table 4-1. The wind generally blows from the South-West to West-Northwest, with the highest percentage coming from the West as marked in orange in Table 4-1.

Table 4-1 The percent occurrence of wind speed and direction from National Data buoy Center Station 46053 is displayed for the direction the wind is coming from, with the largest percent of wind coming from the West.

Wind Speed (m/s)	Direction Wind is Coming From															
	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
0.0 - 1.0	0.8%	0.5%	0.6%	0.7%	0.7%	0.6%	0.6%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.4%	0.4%
1.0 - 2.0	0.6%	0.9%	1.4%	1.7%	1.7%	1.2%	0.9%	0.7%	0.7%	0.6%	0.8%	0.8%	0.8%	0.7%	0.5%	0.5%
2.0 - 3.0	0.4%	0.9%	2.0%	2.7%	2.4%	1.3%	0.7%	0.4%	0.4%	0.4%	0.5%	0.7%	0.8%	0.6%	0.4%	0.3%
3.0 - 4.0	0.2%	0.7%	2.1%	3.2%	2.9%	1.1%	0.4%	0.2%	0.1%	0.2%	0.2%	0.4%	0.6%	0.5%	0.3%	0.1%
4.0 - 5.0	0.2%	0.5%	1.8%	3.1%	3.2%	0.9%	0.3%	0.1%	0.1%	0.0%	0.1%	0.2%	0.4%	0.4%	0.2%	0.1%
5.0 - 10.0	0.2%	0.6%	2.6%	7.5%	11.2%	4.9%	1.2%	0.1%	0.1%	0.0%	0.0%	0.2%	0.9%	1.2%	0.4%	0.1%
10.0 - 15.0	0.0%	0.0%	0.0%	0.1%	2.0%	2.3%	0.5%	0.0%	0.0%		0.0%	0.0%	0.2%	0.2%	0.1%	0.0%
> 15.0					0.0%	0.0%	0.0%					0.0%	0.0%	0.0%	0.0%	

The wind speed and direction are also displayed as a wind rose in Figure 4-2. The most prevalent wind condition is the wind coming from the West at 5 to 10 m/s or 10 to 20 knots.

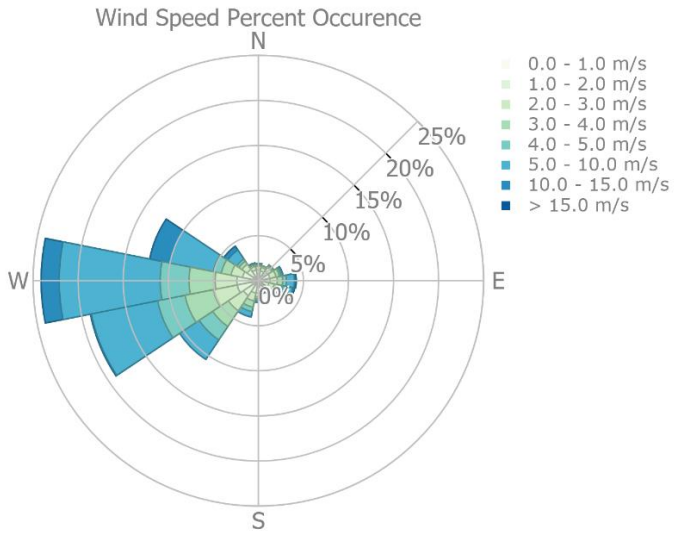

Figure 4-2 Wind speed and direction percent occurrence from National Data buoy Center Station 46053 is displayed in the wind rose as direction the wind is coming from with corresponding percent of speed.

4.1.2 Current

The current speed and direction at the water surface was extracted from the California Regional Ocean Modeling System (ROMS) at the VSE project site from 2012 to 2019 at 6-hour time intervals [3]. The data was summarized and categorized by the speed and direction of the current. The current speeds at the VSE project site were generally less than 0.2 m/s and primarily going to the Southeast or Northwest with some variation, see Table 4-2 and Figure 4-3.

Table 4-2 The percent occurrence of current speed and direction from the California ROMS at 6 hour intervals from 2012 to 2019 is displayed by speed and direction category.

Current Speed (m/s)	Direction Current is Going To															
	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
0.0 - 0.1	2.08%	1.81%	1.85%	1.91%	2.71%	2.69%	2.72%	2.71%	2.27%	2.19%	1.73%	2.37%	2.42%	2.42%	2.89%	2.39%
0.1 - 0.2	1.84%	1.37%	1.63%	2.19%	2.98%	4.99%	5.33%	3.57%	1.72%	1.13%	1.07%	1.39%	2.96%	4.42%	5.47%	3.15%
0.2 - 0.3	0.43%	0.45%	0.15%	0.12%	0.92%	2.09%	3.01%	1.34%	0.28%	0.07%	0.04%	0.11%	0.46%	1.92%	2.46%	0.95%
0.3 - 0.4	0.07%	0.02%			0.05%	0.57%	0.79%	0.13%					0.02%	0.24%	0.40%	0.12%
0.4 - 0.5					0.01%	0.07%	0.15%							0.01%	0.04%	0.01%
0.5 - 0.6						0.02%	0.06%								0.02%	
0.6 - 0.7							0.01%									0.01%

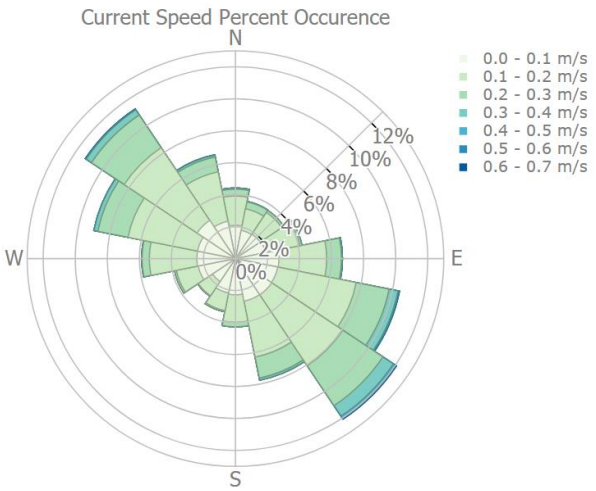

Figure 4-3 The percent occurrence of current speed and direction from the California ROMS at 6 hour intervals from 2012 to 2019 is displayed on the current rose by direction category and percent speed.

4.1.3 Visibility Data (Fog, Haze, etc.)

Hourly visibility data were acquired from the Oxnard Airport, station ID: WBAN: 93110, approximately 10 miles southeast of the proposed site. Hourly observations for a 10-year period from Jan. 1, 2010 through Dec. 31, 2019 were acquired from the NOAA National Climatic Data Center (NCDC) Local Climatological Data portal [4]. Data were filtered to include observations of fog by hour. The 10 years of data contained a total of 1,083 hours of fog observations with associated average visibility of 0.32 nm. Visibility less than 0.5 nm is considered very poor and requires careful navigation [5].

Fog data was tabulated and graphed in Table 4-3 and Figure 4-4, showing a monthly average of 9 hours of fog. There was significant variation between months and years, with some months of 0 hours of fog and others with up to 60 hours of fog reported.

In Southern California, there are two main periods of the year with increased fog, late winter/ early spring (Feb - Mar), and mid to late summer (Aug - Sep). This trend is also seen in Figure 4-4. Other factors can reduce visibility on the water. In recent years, there have been increased occurrences of wildfires in the area, and the 2017-2018 Thomas fire was the second-largest wildfire in modern California history, burning nearly 300,000 acres. Smoke from large wildfires can reduce

visibility nearshore as winds shift from predominantly onshore winds to offshore winds, sending smoke plumes over the ocean.

Table 4-3 Oxnard Airport, California. Hourly fog reported 2010 – 2019

Month	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Average hr/ Month
Jan	11	5	17	6	3	12	3	11	31	11	11
Feb	5	0	4	5	9	13	6	46	12	0	10
Mar	6	9	16	39	0	19	12	56	22	8	18.7
Apr	8	1	1	3	27	0	7	9	5	1	6.2
May	0	2	0	3	0	2	0	5	1	0	1.3
Jun	0	7	0	0	1	5	20	5	2	6	4.6
Jul	2	3	9	9	0	0	4	0	3	9	3.9
Aug	39	4	3	17	4	1	2	6	2	39	11.7
Sep	60	14	17	5	0	1	10	3	7	13	13
Oct	12	32	11	8	9	4	0	5	17	1	9.9
Nov	3	0	36	10	5	0	5	0	5	2	6.6
Dec	15	9	20	2	16	0	38	0	11	3	11.4

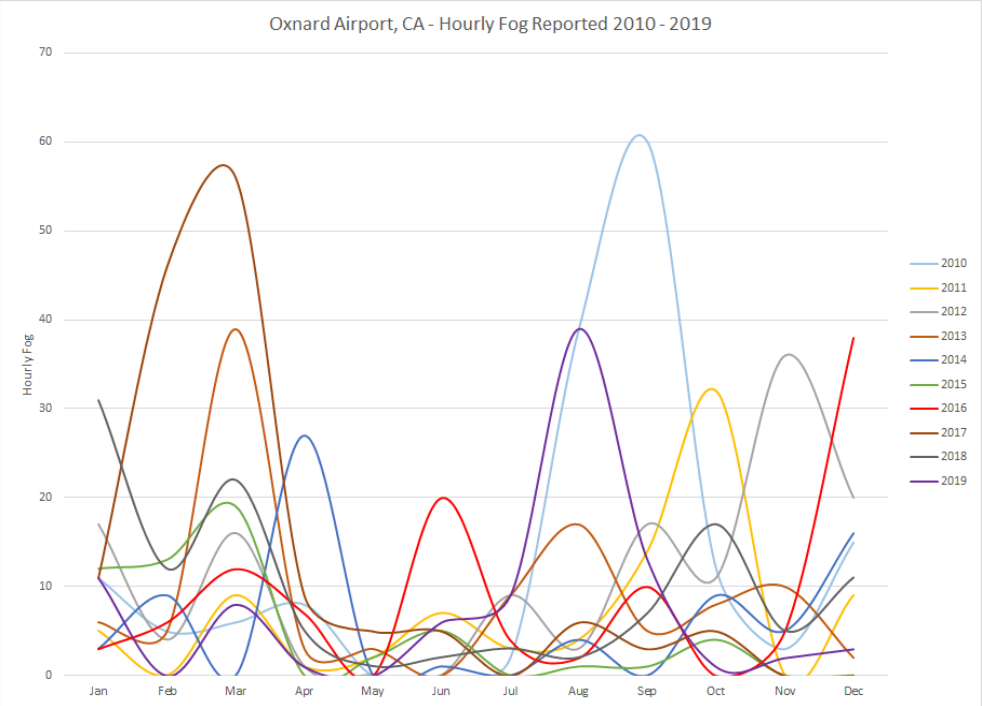

Figure 4-4 Oxnard Airport, California. Hourly fog reported 2010 - 2019

4.1.4 Water depth

Bathymetry data from the Santa Barbara, California 1/3 arc-second MHW Coastal Digital Elevation Model was examined [6]. The VSE project site ranges from 25 to 40 meters in depth, with no hazards shallower than 10 or 15 m in close proximity. The only locations, other than the nearshore zone, with depths shallower than 10 m are within the Channel Islands National Park (see Figure 4-5).

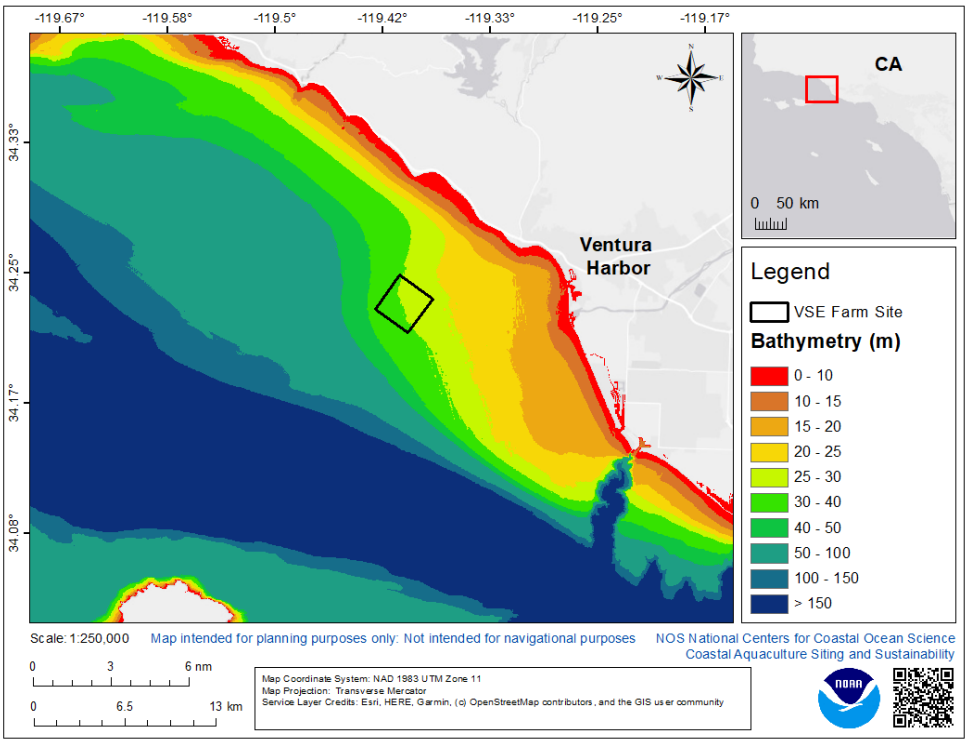

Figure 4-5 Bathymetry data from the Santa Barbara, California 1/3 arc-second MHW Coastal Digital Elevation Model with the VSE farm site displayed.

4.1.5 Tidal variation

Tide Station data from Santa Barbara station 9411340 [7] shows the variation in the water level over the course of year 2019, see Figure 4-6. The Southern California coast exhibits a mixed semidiurnal tidal regime, which means two high and low tides occur daily but differ in size, see Figure 4-7. The tidal variation water level is observed to be approximately 2 m relative to the Mean Lower Low Water level (MLLW).

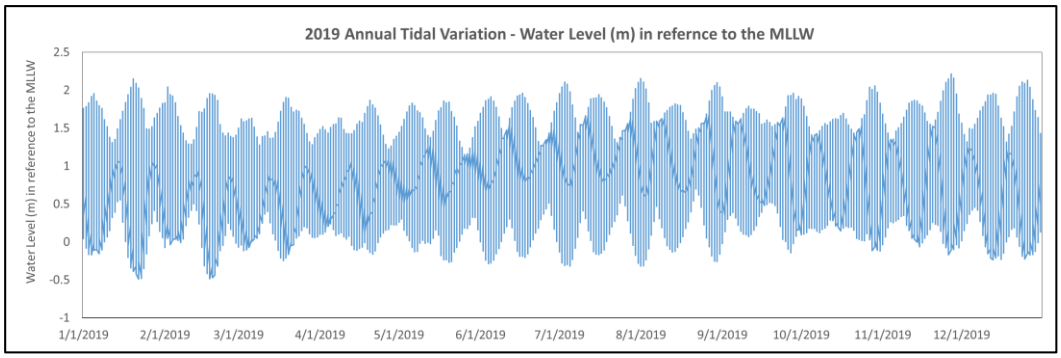

Figure 4-6 Hourly water level heights (m) in reference to the Mean Lower Low Water (MLLW) mark for the Santa Barbara Station 9411340

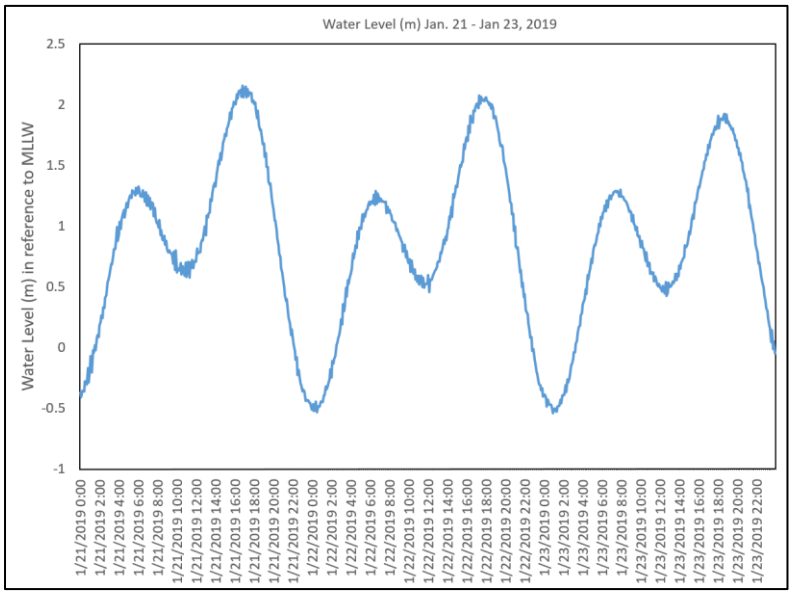

Figure 4-7 Water level height at 6 minute intervals from Station 9411340 from 1/21/2019 to 1/23/2019, showing a mixed semi-diurnal tidal cycle.

4.2 Accident statistics

Accident statistics for the area near and around the project site was obtained from [8] for the years 2001 to 2015. The locations of the accidents are shown in red in Figure 4-8. A review of the accidents within a few nautical miles from the project site shows only a handful of accidents, that were not specifically related to or caused by the specific area.

Considering the area within the Ventura Harbor, a higher number of accidents were registered. A total of 69 records were found representing 50 different accident activities. This represent an average of 3.3 incidents per year. This was supported by the Ventura Harbormaster, who confirmed that accidents occasionally happen, up to a maximum of five per year, typically caused by inattentive or sleeping crew.

The recorded accidents generally involved recreational vessels and commercial fishing vessels. The vast majority of these events were classified with environmental impact in the form of oil discharge. The remaining were either registered as allisions, collisions, grounding, material failure or sinking. Accidents were registered evenly throughout the year with no seasonal trend despite the increased vessel traffic in the summer peak months.

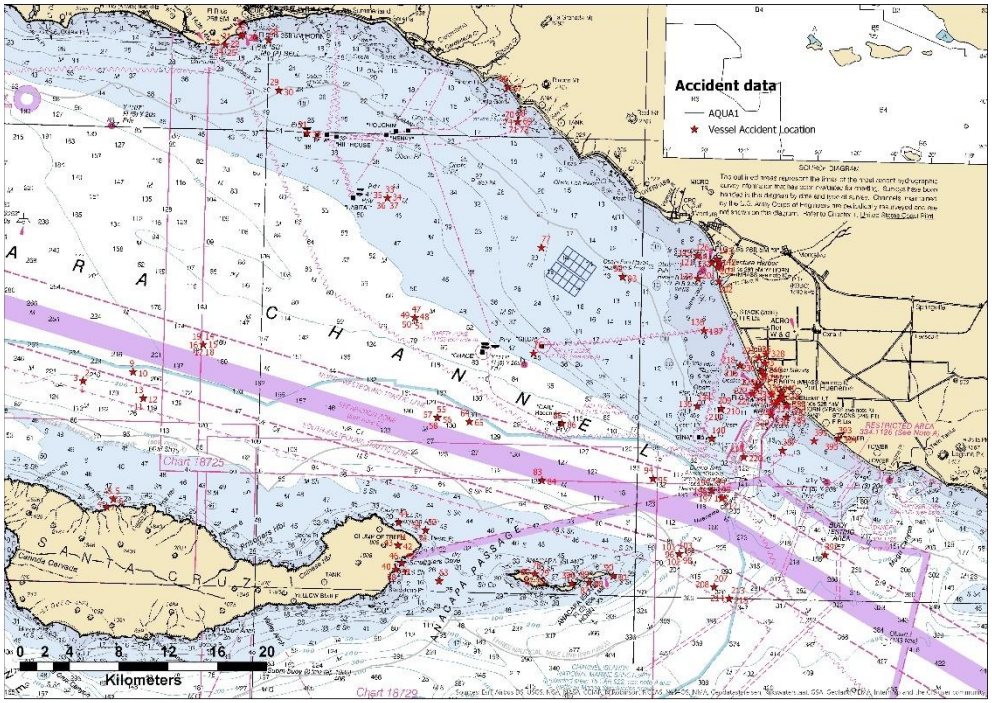

Figure 4-8 Recorded accidents from 2001 to 2015

In addition to the local accident data, one navigation accident related to another aquaculture project should be highlighted. The aquaculture farm Catalina Sea Ranch (CSR), which was located approximately 70 nm south of Ventura, had a tragic accent in 2019 which resulted in one fatality. As described in the Orange County Sheriff's Department report [9], a small recreational fishing boat travelling through the area became entangled with "the approximate 400' section of broken coiled line" associated with the CSR project, which was floating and poorly fastened, and capsized. As concluded by the investigation, the boats "excessive speed through the CSR exacerbated the accident", although the primary cause was the buoyancy and unseen hazard created by the "line tied off to an adjacent line in an attempt to keep it out of the way".

4.3 Vessel traffic survey

Various data sources have been analyzed and evaluated to understand vessel traffic near the VSE project site, including information obtained from the VSE project team, including the Ventura Harbor Harbormaster, and outreach to stakeholders. The primary data sources are the following:

- Automatic Identification System (AIS) data
- Recreational fishing data from CDFW
- Commercial fishing data from CDFW
- Information regarding marine events (sailboat races)

AIS data is the primary data source used for the commercial vessel traffic survey presented in this Chapter [10]. Additional information for recreational and

commercial fishing vessel traffic data is used to provide information on smaller vessels that do not typically carry AIS, see Chapter 4.3.9 and 4.3.10.

4.3.1 AIS data

AIS is generally required for commercial vessels greater than 1600 gross tons or with a length of 65 ft or more, in addition to other specific USCG requirements, see Table 4-4. Larger recreational vessels, such as pleasure craft or sailing vessels, sometimes choose to carry an AIS transponder, even though it is not mandatory.

Table 4-4 Vessels generally required by the United States Coast Guard to carry Automatic Identification Systems (AIS). Additional rules and restrictions apply.

USCG Vessels Required to Carry Automatic Identification System (AIS)
A self-propelled vessel of 1600 or more gross tons
A self-propelled vessel of 65 feet or more in length, engaged in commercial service.
A towing vessel of 26 feet or more in length and more than 600 horsepower, engaged in commercial service.
A self-propelled vessel that is certified to carry more than 150 passengers.
A self-propelled vessel engaged in dredging operations in or near a commercial channel or shipping fairway in a manner likely to restrict or affect navigation of other vessels.
A self-propelled vessel engaged in the movement of certain dangerous cargo
A self-propelled vessel engaged in the movement of flammable or combustible liquid cargo in bulk
A self-propelled fishing industry vessel

AIS transmissions are collected by the USCG via a number of land based stations [11]. NOAA's Office of Coastal Management (OCM), in conjunction with the Bureau of Ocean Energy Management (BOEM), takes the raw data from the USCG and performs a number of operations to improve the quality and completeness of the data, and makes the final product available to the public [12]. AIS data from 2017 was used for this project, as the 2018 and 2019 AIS data was not available at the time of processing. AIS data from 2013 and 2015 were also examined in relation to 2017 to evaluate temporal trends in the vessel traffic. The processed AIS transmissions from https://marinecadastre.gov/ais/ were downloaded, and point shapefiles were created. The time fields within the point shapefiles were used to create vessel transits, see Figure 4-9 [13].

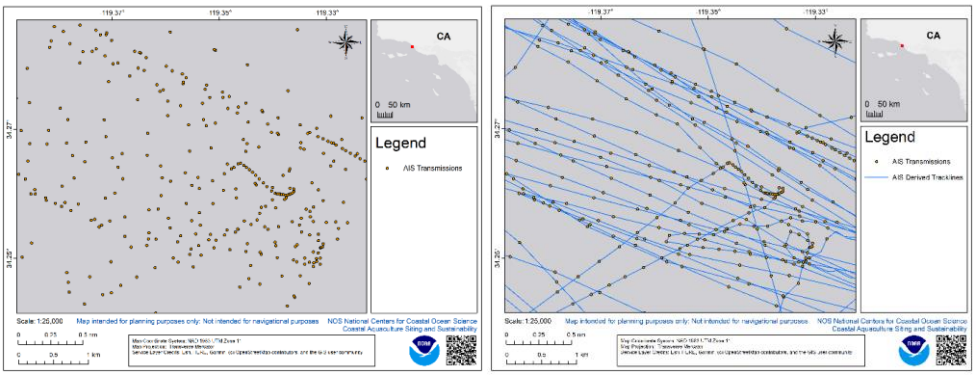

Figure 4-9 (Left) AIS transmissions plotted as point data. (Right) derived tracklines based on time field and vessel ID in the AIS transmission points.

4.3.2 Traffic density

Vessel density maps were created to identify commonly used routes and areas where there is a high density of vessel traffic. Vessel density surfaces were created from the AIS vessel tracklines using tools developed by NOAA [14]. These tools take the AIS tracklines and calculate the density or sum per grid cell for a user defined area. The density maps created use a cell size of 100 m by 100 m, with the color representing the number of vessels that passed through that cell during one year, in this case 2017. The vessel traffic density map from 2017 is shown in Figure 4-10.

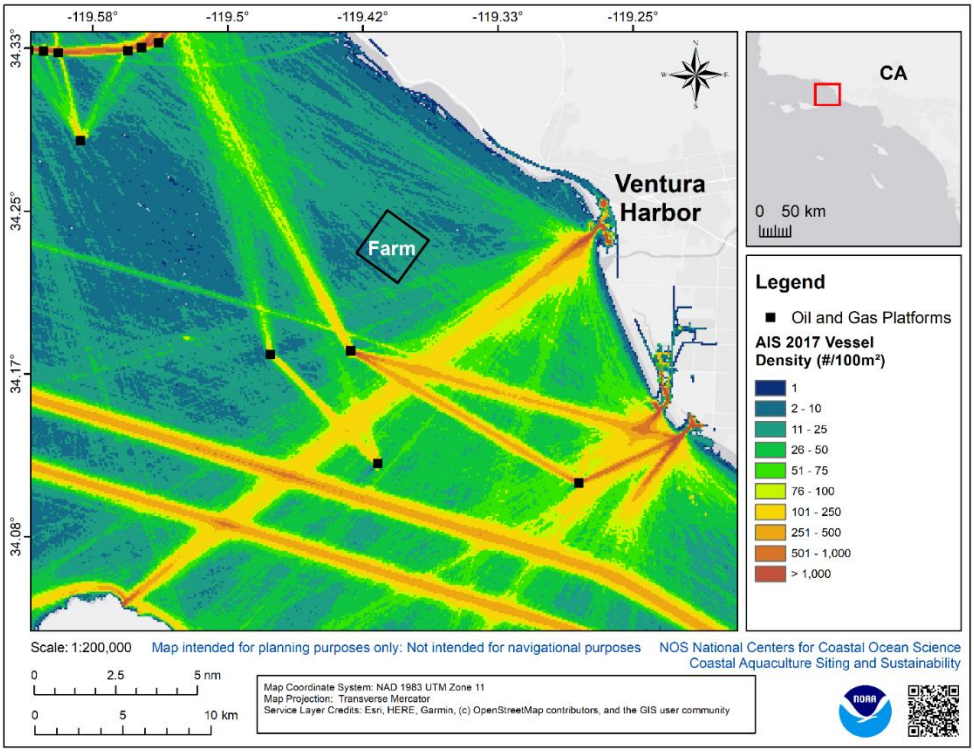

Figure 4-10 AIS vessel density where each cell has the total number of vessels that transited through it during 2017.

4.3.3 Typical routes

Examination of the vessel density allowed for the identification of the typical routes vessels in the area use. In addition, the area around the project site was also examined, even though the vessel traffic is more scattered in this area without clear routes. In total 13 areas and routes were delineated, see Figure 4-11. Routes such as the Santa Barbara Channel Traffic Separation Scheme (TSS) (10-1 and 10-2) are official shipping lanes and will have larger vessels, while routes 6, 7, 8, and 9 are mainly vessels in transit to the offshore oil and gas platforms from Port Hueneme, Channel Islands Harbor, and Santa Barbara Harbor, see Figure 4-10. Route 5 has the highest density of vessel traffic transiting to and from Ventura Harbor and Channel Islands National Park. Routes 1, 2, 3, 4, and the project site have relatively lower traffic.

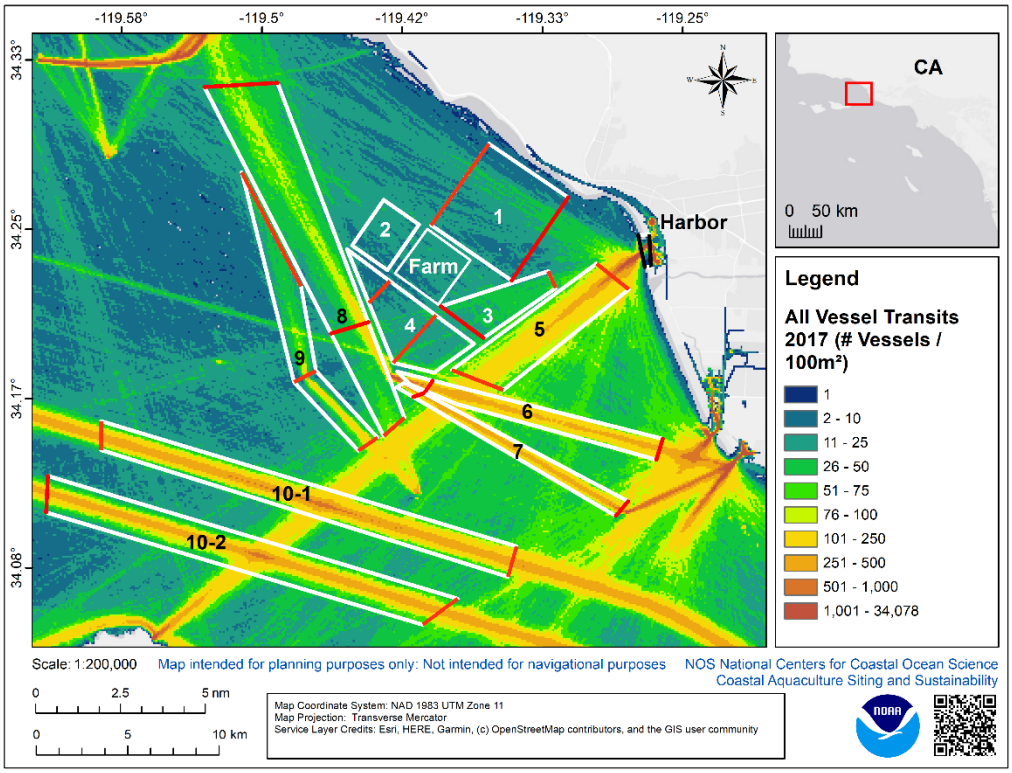

Figure 4-11 Examination of vessel transit density in proximity to the farm yielded 13 areas/routes (including the Farm and Ventura Harbor). Area/Route Start and End, and in the case of 8 and 9, a Middle line, are shown in red.

Start and end crosslines were defined as geographical lines that vessels may have crossed, and only tracks that intersect with the start and end lines are included in the summary tables, see Figure 4-12. For Route 8 and 9 there is a middle crossline, so as long as a vessel track intersected with the start – end, start – mid, or mid – end crosslines that track was included. For the project site and Area 2, all vessels that entered were considered, with no start, middle, or end crosslines defined. Once the vessel transits were identified, transmission points that overlap with the vessel transits are extracted and speed data calculated for individual vessels.

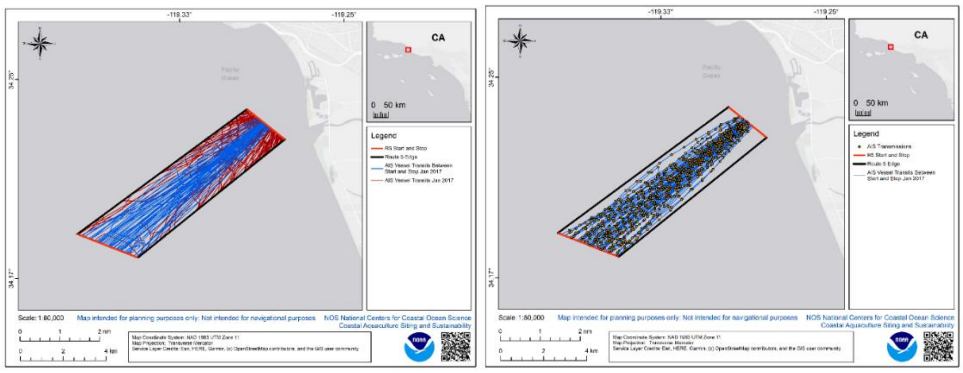

Figure 4-12 (Left) All the transits are clipped to the route, and only those transits that intersect with both the Start and End crosslines are extracted for the summary table. (Right) The AIS transmissions that overlap with the transits that went between the start and end crossline are used to extract the vessel speed, which is the vessels current speed at the point of transmission. Summary tables of each route and area are created, and include information about the number of vessels, the speed of the vessels, the length, the draft, and seasonal patterns.

The Maritime Mobile Service Identity (MMSI) is used to identify each vessel, and the max and mean speed of vessels is calculated using the transmitted speed from the vessel. Any speeds < 1 knot were removed as the vessel could be anchored, moored, or drifting. The speed data is summarized for each unique vessel, and a max and mean speed for each individual vessel is recorded. The summarized max speed is the fastest speed recorded by all vessels of a certain type and classification. The summarized mean speed is the mean speed of all individual vessels (n=the number of vessels), as this ensures each vessel is represented equally.

Vessel length and draft summary tables were also created for each of the routes and areas and utilize the same definition of a vessel transit as above. In the case of missing length or draft information from the AIS transmissions, three methods were used:

1. Vessels with missing length and draft values were manually looked up using the vessel-specific MMSI through online databases (fleetmon.com, marinetraffic.com, and fcc.gov).

2. Vessels with known lengths but missing draft data, had the drafts calculated based on a linear equation from a database created for the AIS data in Southern California, which contained 3,300 vessels of known vessel length, width, and draft, see Figure 4-13.

3. Vessel data was also indexed and cross-referenced from values previously looked up or interpolated using methods 1 and 2.

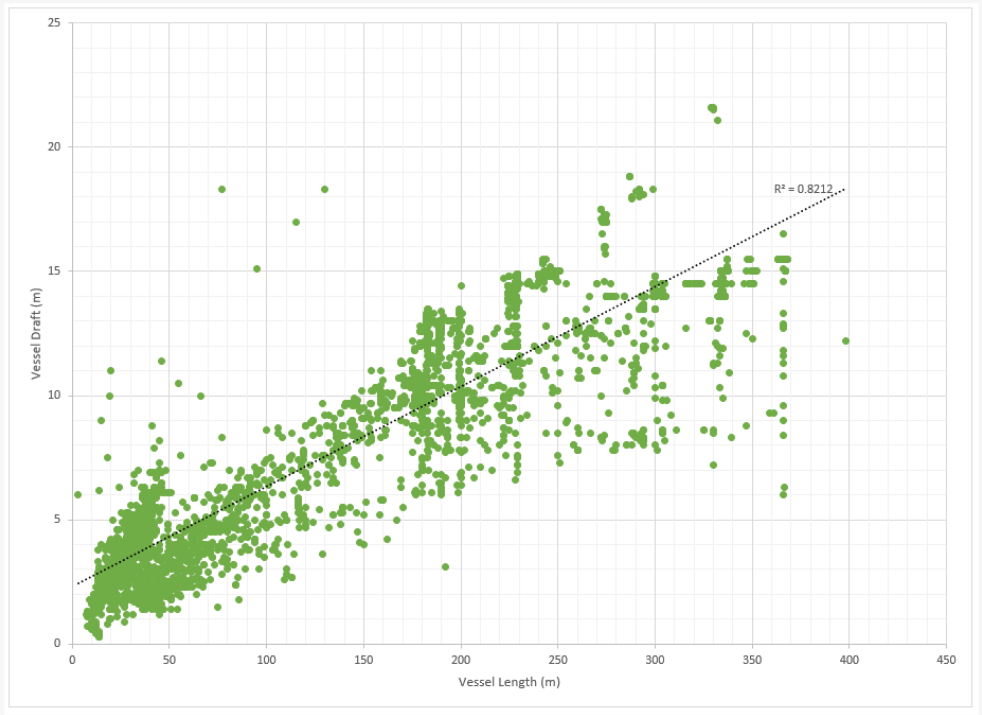

Figure 4-13 Scatter plot of 3,300 individual vessels by vessel length and vessel draft with a linear line fit to the data, of which the equation of the line was used to calculate the vessel draft of vessels with no reported draft based on the length of that vessel.

4.3.4 Vessel traffic areas

Five areas are defined to better summarize and analyze the vessel traffic that was observed from the AIS data, see Figure 4-14. The areas are defined based on their proximity to the VSE project site.

Area A is the proposed project site, Area B is the area around the project site, Area C is the vessel traffic going to and from Ventura Harbor, Area D contains the other routes nearby, and Area E is the TSS route.

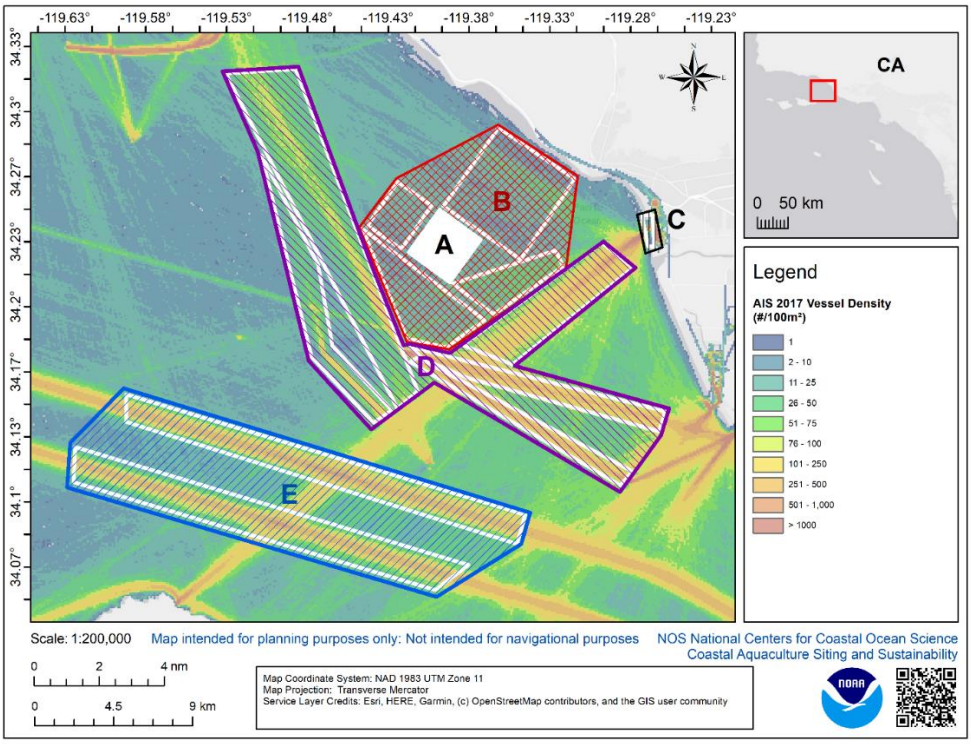

Figure 4-14 Five areas A-E were created based on their relationship to the project site, and used to summarize the vessel traffic from the routes and locations contained within.

Area A

In 2017, there were 151 unique vessels that made 382 transits through the project site using their AIS transponder. Passenger vessels and recreational pleasure craft made the greatest amount of transits through the area (63%), and generally traveled the fastest through the area with mean speeds between 10 and 13 knots. 19 commercial fishing vessels transited the area a total of 35 times during 2017. Vessel lengths were predominantly between 50 to 100 feet, with some larger vessels making occasional passages. Nearly all vessel drafts were less than 15 ft, with only 6 vessel transits having drafts greater than 15 ft, see Table 4-5 to Table 4-9.

Area B

The areas around the farm site had 344 unique vessels make 1026 transits during 2017. Recreational pleasure craft and passenger vessels were also dominating in this area, together with a number of offshore supply vessels, oil recovery vessels, and commercial fishing vessels, see Appendix A. Passenger and pleasure craft had the fastest recorded speeds through this area with an average of 10-12 knots. Most vessels that transited through this area had lengths less than 100 ft and the vast majority of the vessel transits had drafts less than 15 ft, see Table 4-5 to Table 4-9.

Area C

Ventura Harbor (Area C) had 228 unique vessels that made 5306 AIS recorded transits in and out of the Harbor during 2017. About half of all transits were from passenger vessels, with recreational pleasure craft and commercial fishing passages being the next highest. Area C had the slowest vessel speeds with all average speeds less than 6 knots. Slower speeds are expected given the entry/exit into the harbor. All vessels that entered the harbor were less than 200 ft in length, with only 1.7% of transits estimated to having a draft deeper than 15 ft, see Table 4-5 to Table 4-9.

Area D

The surrounding area consists of well-defined vessel routes and the lowest number of unique vessels, with only 84 vessels making 3909 transits. 3672 voyages were from passenger vessels, either in-route to the offshore islands or offshore oil and gas platforms. Passenger and pleasure craft generally had the fastest recorded speeds through this area with both around 28 knots and averages between 8-16 knots. All vessels were less than 200 ft long, with nearly all transits having drafts less than 15 ft, see Table 4-5 to Table 4-9.

Area E

As to be expected, the TSS area had the largest number of cargo and tanker vessels, with 1715 unique vessels making 3591 transits through this area during 2017. The vast majority of these vessels were cargo vessels, with 2892 freight ship transits. Cargo, passenger, tanker, and pleasure craft had the fastest speeds while transiting this area ranging from an average between 12-13.5 knots. Additionally, this area had the longest vessels with the deepest drafts, with 93% of transits having vessels longer than 500 feet and 96.7% of vessel transits having drafts greater than 15 ft, see Table 4-5 to Table 4-9.

Table 4-5 Total number of unique vessels in 2017 from all routes within each area by vessel category.

Vessel Category	**Area**				
	A	**B**	**C**	**D**	**E**
Cargo					1265
Fishing	19	46	35	14	5
Not Available	1	4	2	1	
Other	33	83	58	20	95
Passenger	16	47	26	19	23
Pleasure Craft/Sailing	79	160	104	29	28
Tanker					265

Tug Tow	3	4	3	1	34
Total	**151**	**344**	**228**	**84**	**1715**

Table 4-6 Total number of voyages in 2017 from all routes within each area by vessel category.

Vessel Category	**Area**				
	A	**B**	**C**	**D**	**E**
Cargo					2934
Fishing	35	107	611	32	5
Not Available	33	38	38	1	
Other	72	345	1170	122	150
Passenger	131	287	2575	3672	39
Pleasure Craft/Sailing	108	245	905	81	28
Tanker					332
Tug Tow	3	4	7	1	103
Total	**382**	**1026**	**5306**	**3909**	**3591**

Table 4-7 AIS 2017 mean vessel speed (knots) by vessel category for each area.

Vessel Category	**Mean Vessel Speed (knots) by Area**				
	A	**B**	**C**	**D**	**E**
Cargo					13.5
Fishing	9.2	8.3	5.75	7.7	9.1
Not Available	6	8.7	4.7	3.7	
Other	11.6	12.5	5.6	13	11.4
Passenger	12.9	12.3	5.5	15.9	13.4
Pleasure Craft/Sailing	10.1	10	4.9	8.2	12.7
Tanker					12
Tug Tow	7.6	6.2	4.3	5.4	7.9

Table 4-8 AIS 2017 total number of voyages by vessel length for each area.

Areas	Vessel Lengths (ft)								
	Unknown	**1-50**	**50 - 100**	**100-200**	**200-300**	**300-400**	**400-500**	**500-1000**	**> 1000**
A		90	225	61	6				
B	22	251	582	169	2				
C	93	1275	3766	172					
D	15	105	2979	810					
E	4	1	30	116	31	11	53	2382	963
Total	134	1722	7582	1328	39	11	53	2382	963

Table 4-9 AIS 2017 total number of voyages by vessel draft for each area.

	Vessel Draft (ft)							
Area	**Unknown**	**1-10**	**10-15**	**15-20**	**20-30**	**30-40**	**40-50**	**>50**
A	3	183	190	6				
B	17	581	426	2				
C	90	4139	1075		2			
D	6	1455	2448					
E	2	30	89	69	286	773	2026	316
Total	118	6388	4228	77	288	773	2026	316

4.3.5 Seasonal traffic variances

Analysis of the monthly vessel transits through the different Areas reveals that Areas A and B have the lowest number of transits, with the months of July through September having elevated vessel traffic. Area C, the vessel traffic in and out of the Ventura Harbor, and Area D, have the strongest seasonal changes with low traffic in January and February, and then a gradual increase peaking during July and August. Area E, the TSS, has relatively low seasonal variation, see Table 4-10 and Figure 4-15.

Table 4-10 AIS 2017 total number of vessel voyages during each month from each of the areas

Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
A	31	17	27	29	29	25	54	44	55	34	16	21

B	68	43	51	79	80	72	114	120	123	103	89	84
C	257	251	366	431	441	445	624	532	461	489	518	491
D	270	212	228	228	306	352	438	536	417	304	327	291
E	301	260	295	285	330	300	306	318	307	287	293	309
Total	**927**	**783**	**967**	**1052**	**1186**	**1194**	**1536**	**1550**	**1363**	**1217**	**1243**	**1196**

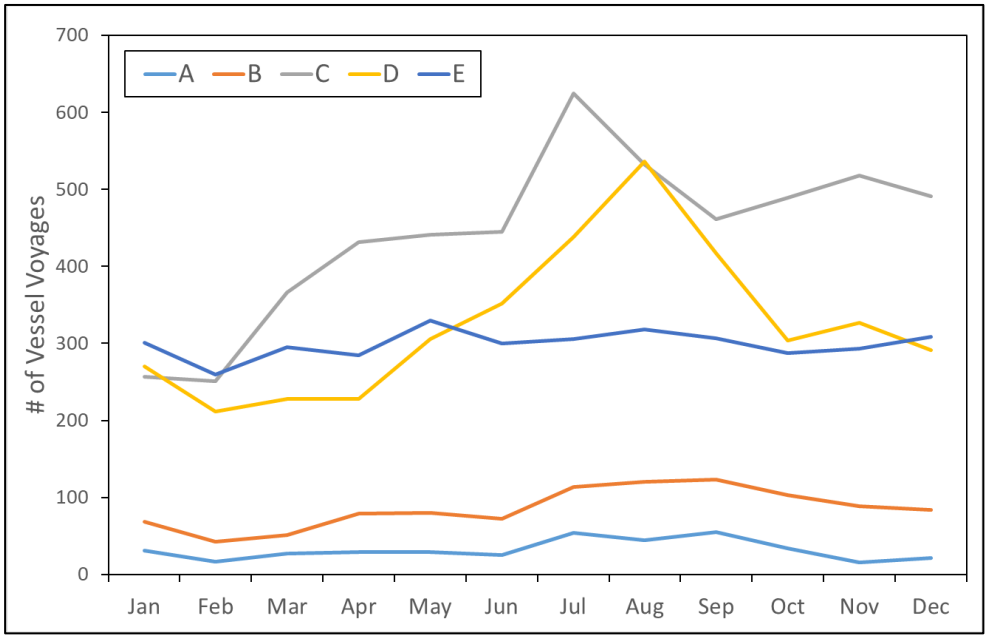

Figure 4-15 AIS 2017 total number of vessel voyages during a month from each of the areas.

4.3.6 Long Term Trends in Traffic

Generally, the number of voyages that occurred within each area during 2013, 2015, and 2017 has increased when considering AIS data alone. Areas A, B, and D displayed slight increases in the number of voyages, while Area C (Ventura Harbor) and Area E (TSS) witnessed the greatest increases, with a 64% and 60% increase, respectively, detected using AIS from 2013 through 2017.

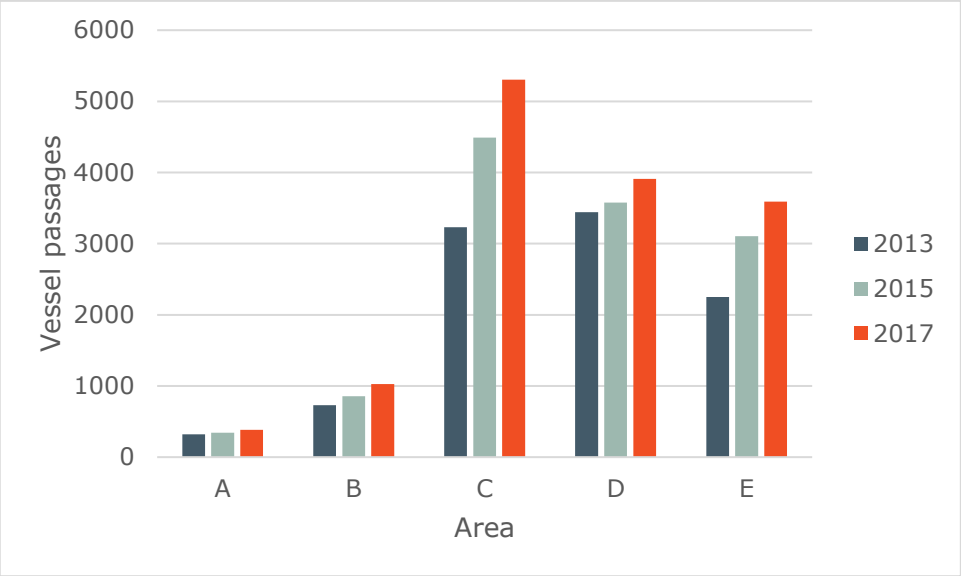

Figure 4-16 Historic trends in vessel traffic within different areas

Table 4-11 Annual Trends in AIS Vessel Traffic by each Area with total voyages occurring within each area in 2013, 2015, and 2017.

Area	2013	2015	2017	Average annual percent increase
A	319	344	382	5%
B	731	857	1026	9%
C	3232	4491	5306	14%
D	3444	3576	3909	3%
E	2251	3104	3591	13%

4.3.7 Harbor and port origin for vessel traffic through the project site

To better assess how the farm may impact vessels from certain ports, the origin and ports visited were assessed. This was performed by extracting all voyages made by a vessel that transited through the VSE project site, and then examining which ports were the origin/destination of the vessels.

Chapter 4.3.4 and Table 4-6, show that the majority of the traffic through the project site was recreational pleasure craft and passenger vessels. In addition, a limited number of fishing vessels were recorded from the AIS data.

Some passenger vessel transits from Ventura Harbor did transit the project site; however, most were in transit to the Channel Islands, with the majority of passenger vessel transits originating from Port Hueneme. Vessels from Port Hueneme made numerous trips to offshore oil and gas platforms in the area, see Figure 4-17. Few pleasure and sailing vessels from Ventura Harbor transited through the project site, with most transits occurring from vessels going between Santa Barbara Harbor and Channel Island Harbor and vice versa, see Figure 4-18. The AIS 2017 fishing vessel transits were predominantly from Ventura Harbor, which indicates that some local fishing traffic from the Ventura Harbor would be transiting through the project site, see Figure 4-19. A mix of other vessels transiting from all four harbors made transits through the project site during 2017, see Figure 4-20. These were local fishing traffic, as well as non-local pleasure/sailing traffic and passenger vessel traffic.

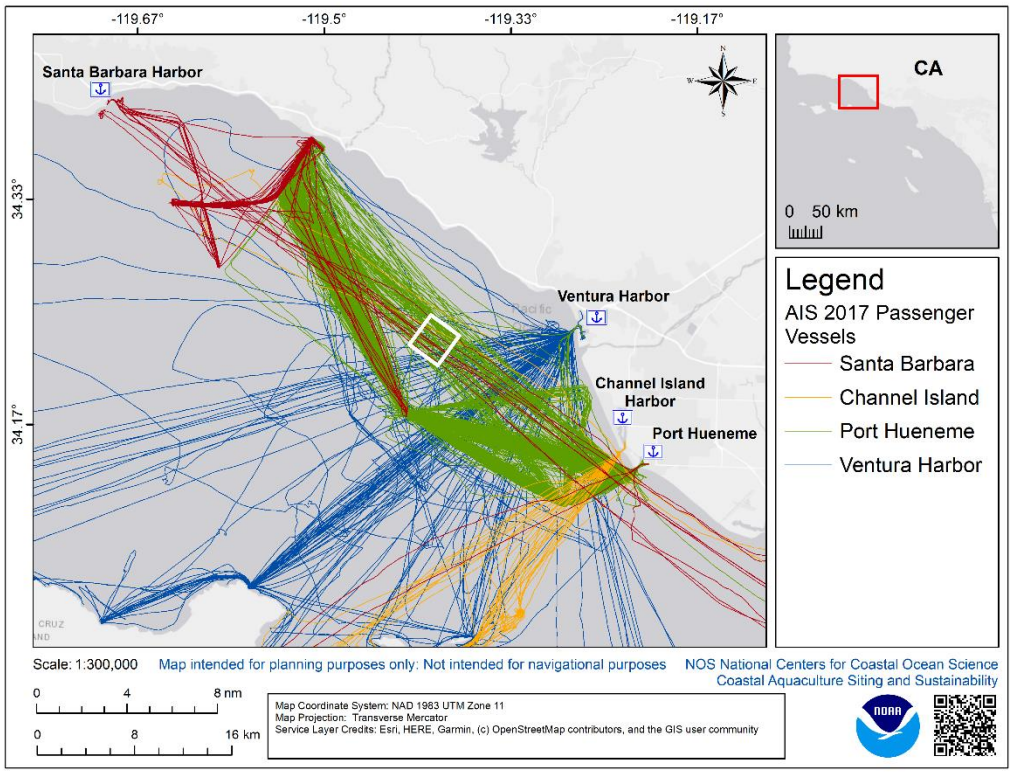

Figure 4-17 Passenger vessel transits from Ventura Harbor and Port Hueneme made up the majority of all transits made by passenger vessels in 2017 through the project site (outlined in white).

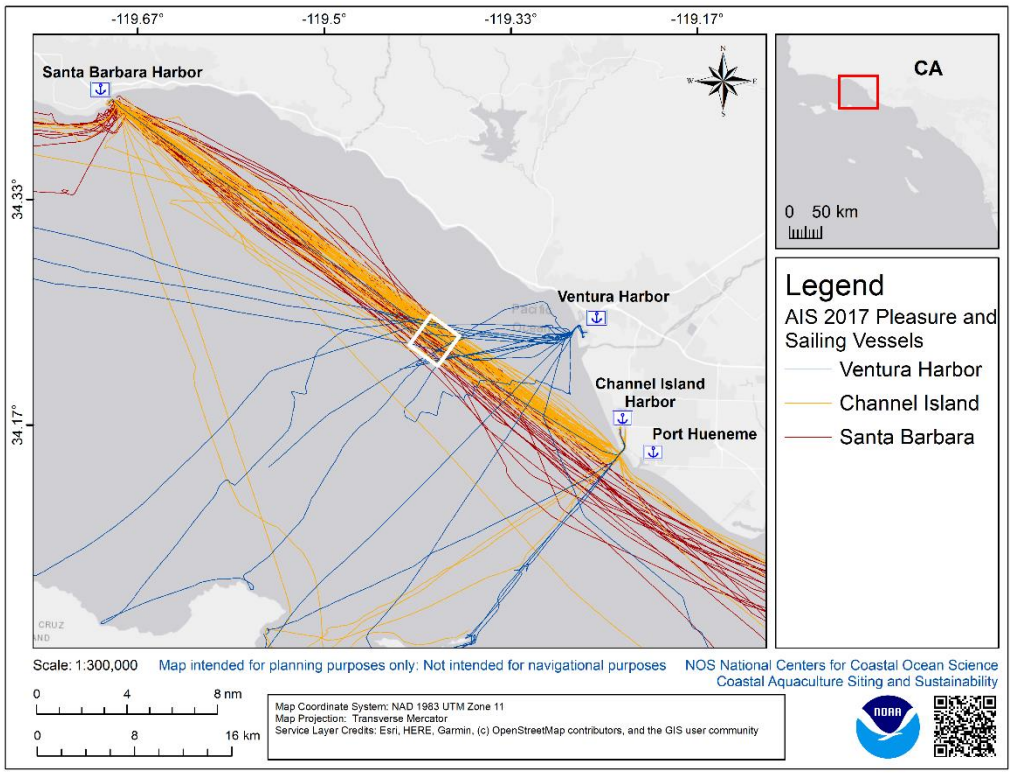

Figure 4-18 Pleasure and sailing vessels transiting from Santa Barbara Harbor to the Channel Island Harbor and vice versa made the majority of all transits during 2017 through the project site (outlined in white).

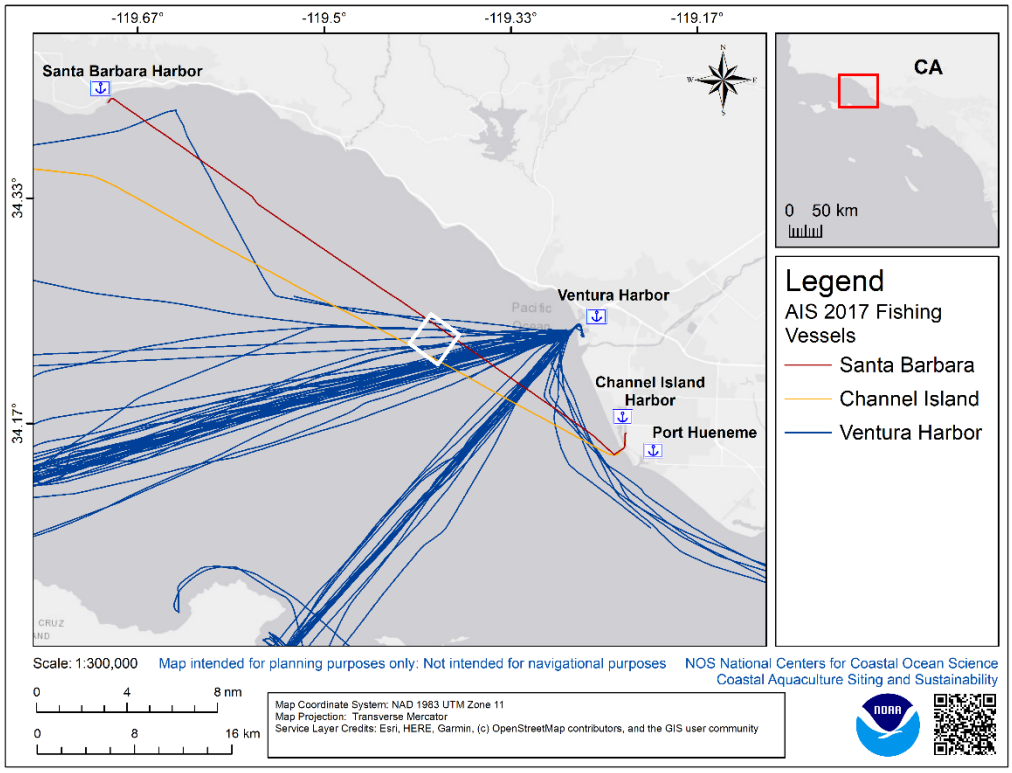

Figure 4-19 Fishing vessel transits from Ventura Harbor made up the vast majority of all transits made by fishing vessels in 2017 through the project site (outlined in white).

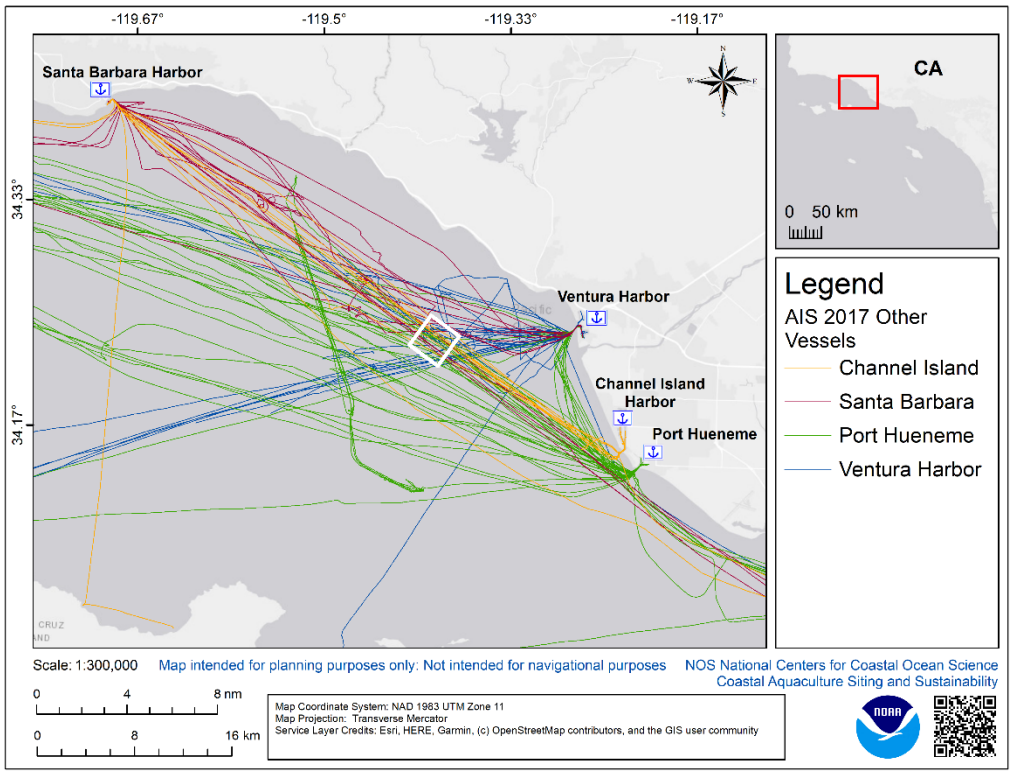

Figure 4-20 A mix of other vessels transiting from all four harbors (Santa Barbara Harbor, Ventura Harbor, Channel Island Harbor, and Port Hueneme) made transits through the project site (outlined in white) during 2017.

4.3.8 Marine events in the area

Figure 4-21 contains a point layer of sailing race markers offshore of Ventura. Points were created using the description, latitude, and longitude for each of the marks. Individual races would use a combination of these marks to create a sailing course depending on various factors including weather conditions and number of vessels in a race. In 2019, the Association of Santa Barbara Channel Island Yacht Clubs (ASBCYC) listed a total of 127 sailing events in the area. These events include both long distance races around the neighboring Channel Islands and nearshore sailing events.

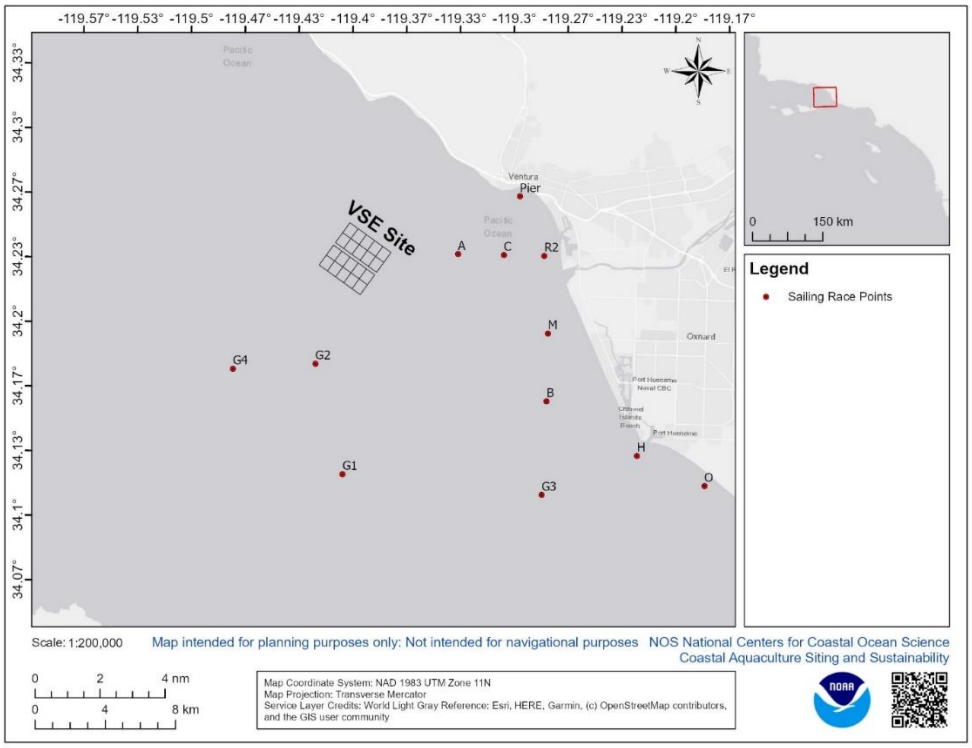

Figure 4-21 Ventura nearshore race course marks.

4.3.9 Vessels without AIS

While some vessels voluntarily decide to use AIS even when not required, not all vessels send and transmit AIS. Additionally, a number of vessels carry only an AIS receiver in order to safely pass through the TSS on route to the Channel Islands.

There is no official data concerning the number of vessels that enter and exit Ventura Harbor; however, the Ventura Harbor Harbormaster has provided information based upon his experience concerning the overall vessel traffic in Ventura Harbor and to what extent AIS is used.

Generally, vessels without AIS are often recreational in nature whereas larger commercial vessels tend to use AIS. AIS use varies on commercial fishing boats, where some do not use AIS.

Generally, there is a much higher degree of seasonality when it comes to recreational vessels as compared to commercial vessels. Based upon AIS data, there is approximately four times as many recreational vessels in the summer months compared to the winter, whereas there is approximately twice as many commercial vessels in Areas A, B and C during the same timeframe.

Based upon AIS data, there are approximately 20 vessels registered as entering and leaving Ventura Harbor per day in the peak summer season. Based upon information from the Harbormaster, for all vessels (including those without AIS), the total number of vessels entering and leaving can (under the most exceptional peak conditions) be as high as 450 per day, but typically is between 100 and 200 vessels per day.

The general observation from the Harbormaster is that the majority of vessels without AIS do not travel far from shore and are therefore unlikely to pass near the project site. Vessels that may go near the project site without AIS are generally limited to a few smaller recreational or commercial fishing vessels.

4.3.10 Fishing

Commercial Fishing

There are various commercial fisheries that operate in the Santa Barbara Channel. Figure 4-22 below shows the estimated average commercial catch in millions of tons for 2012 – 2017. Data is displayed by CDFW block at a 10 nautical mile resolution. The project site has been located to avoid the most popular areas for commercial fishing. The areas southeast of the farm and southwest near Channel Islands are expected to have significantly more commercial fishing activity compared to the area near the project site.

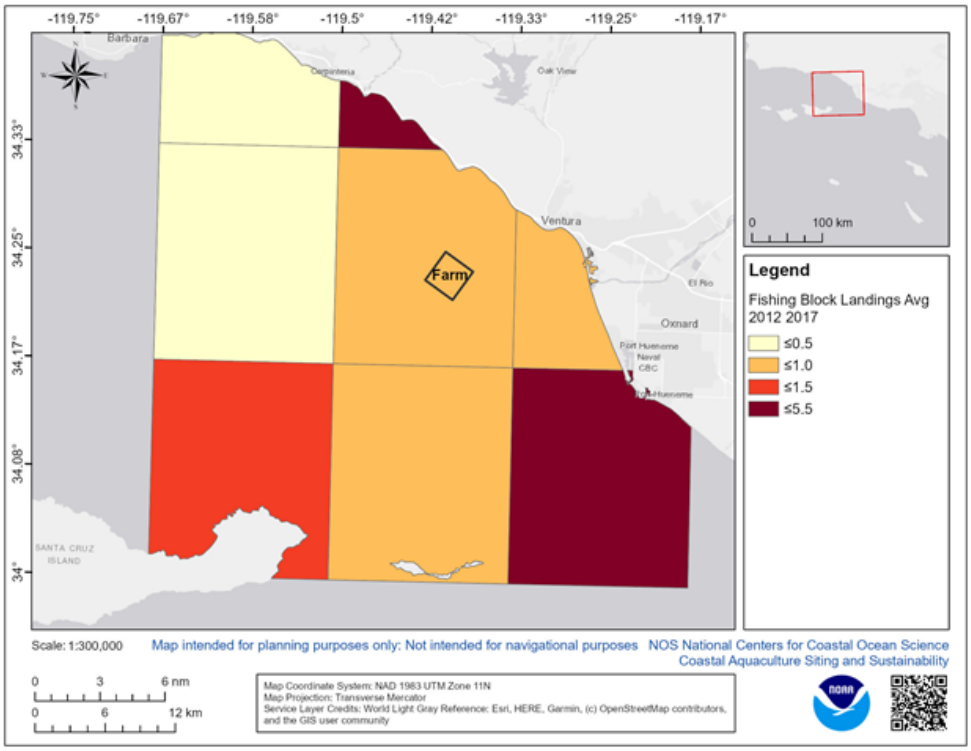

Figure 4-22 Estimated catch by CDFW fishing block data (10 nm) showing average landings per year from 2012 – 2017 in millions of pounds.

The commercial squid fishery that operates in California is highly variable per year by location and total catch. The fishery operates year round with a limited entry permit of 55 vessels per year with a total permitted catch for the fishery of 118,000 short tons. The squid fishery is unique in using light as bait to attract squid such that fishing can occur at any spot within the larger fishery area. Figure 4-23 below shows the average catch in short tons per CDFW microblock at a 1 nautical mile resolution. The most popular areas are near Channel Islands and off the coast of

Port Hueneme. The area at the northern perimeter of the project site has also been subject to squid fishing in the past.

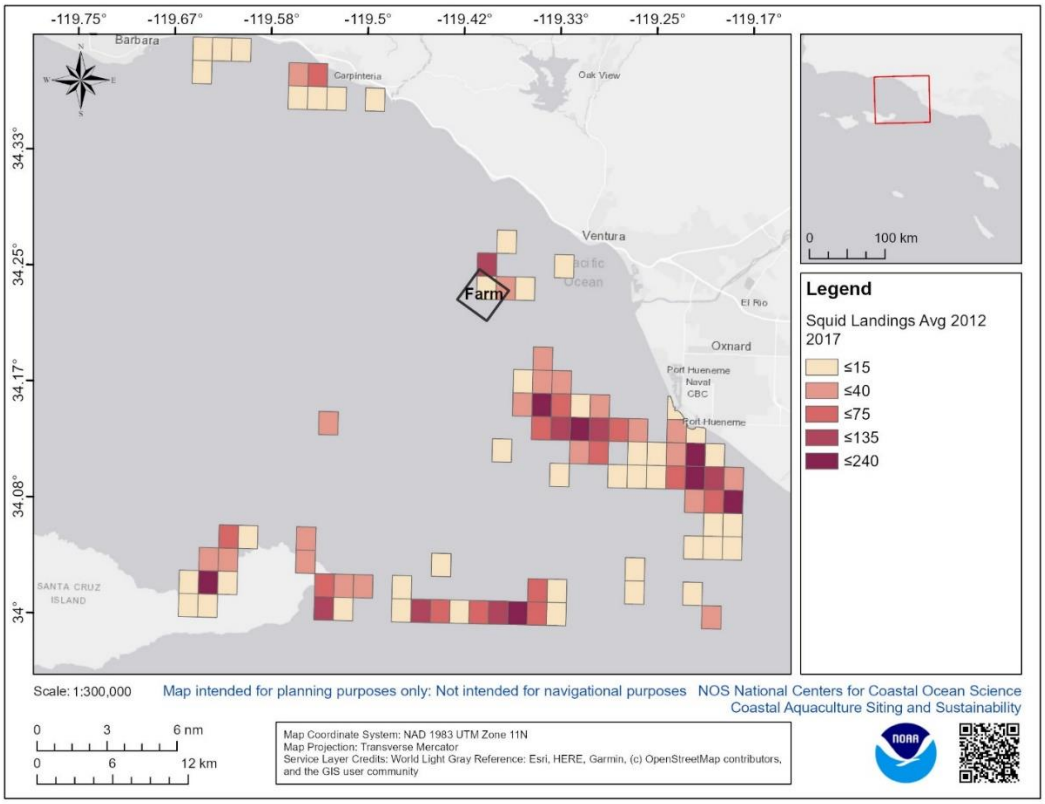

Figure 4-23 Estimated catch by CDFW squid microblock (1 nm) showing average landings per year from 2012 – 2017 in short tons.

The trawl fishery operates within the CDFW trawl grounds which extend from 1-3 nautical miles from shore and North to South from Point Conception to Point Magu. This fishery operates from June to March with a seasonal closure to protect spawning fish species. Figure 4-24 below was created by mapping the total trawl density lines based on a start and end points derived from the CDFW trawl fishing Vessel Monitoring Systems (VMS) dataset from 2010 – 2016, with typical trawling speeds being in the order of 2 to 5 knots. Trawling is observed throughout most of the area including the project site, and the most visited area for trawling appears to be approximately 10 nm northwest of the project site. Figure 4-25 shows AIS data from fishing vessels from 2017, which shows a high density of fishing vessel traffic from Santa Barbara, Ventura, and Port Hueneme towards the Channel Islands and relatively few fishing vessel transit lines in and around the project site.

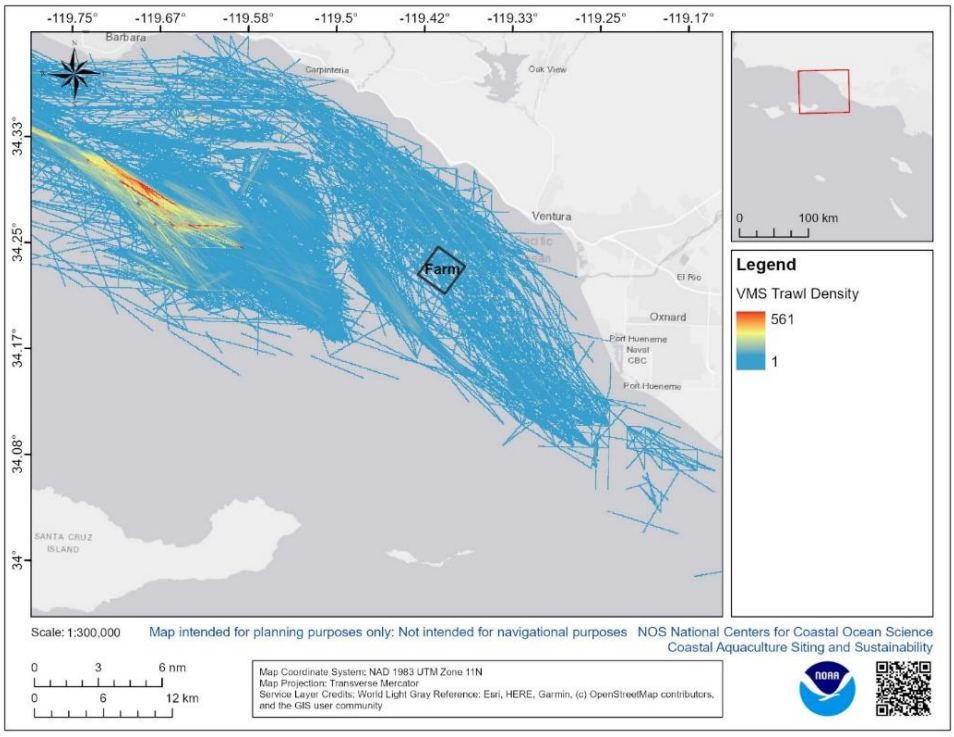

Figure 4-24 Vessel Monitoring System (VMS) density for trawl fishery, showing trawl tracks from 2010 – 2016.

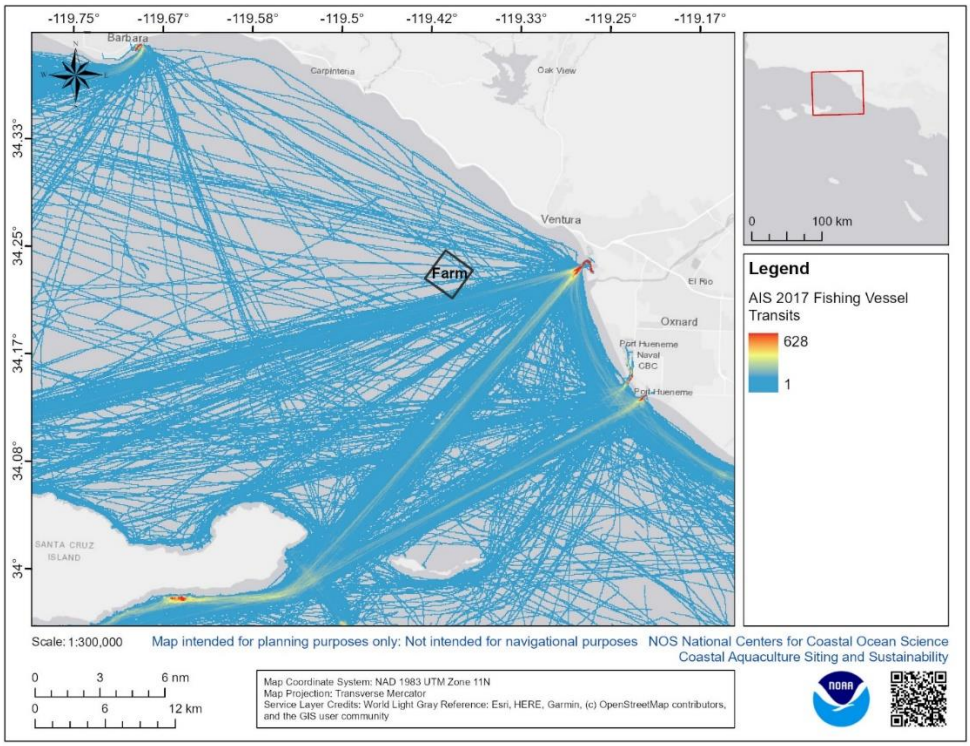

Figure 4-25 AIS fishing vessel category for 2017, showing density of transits.

Recreational Fishing

CDFW Commercial Passenger Fishing Vessel (CPFV) data comprised of GPS points from 2010 – 2019 was aggregated to microblock (1 nm) resolution. Figure 4-26 below was created from the count of unique vessels per block per day, shown as the average number of vessels per year per microblock. As shown by this data, no significant recreational CPFV fishing activity has occurred near the project site.

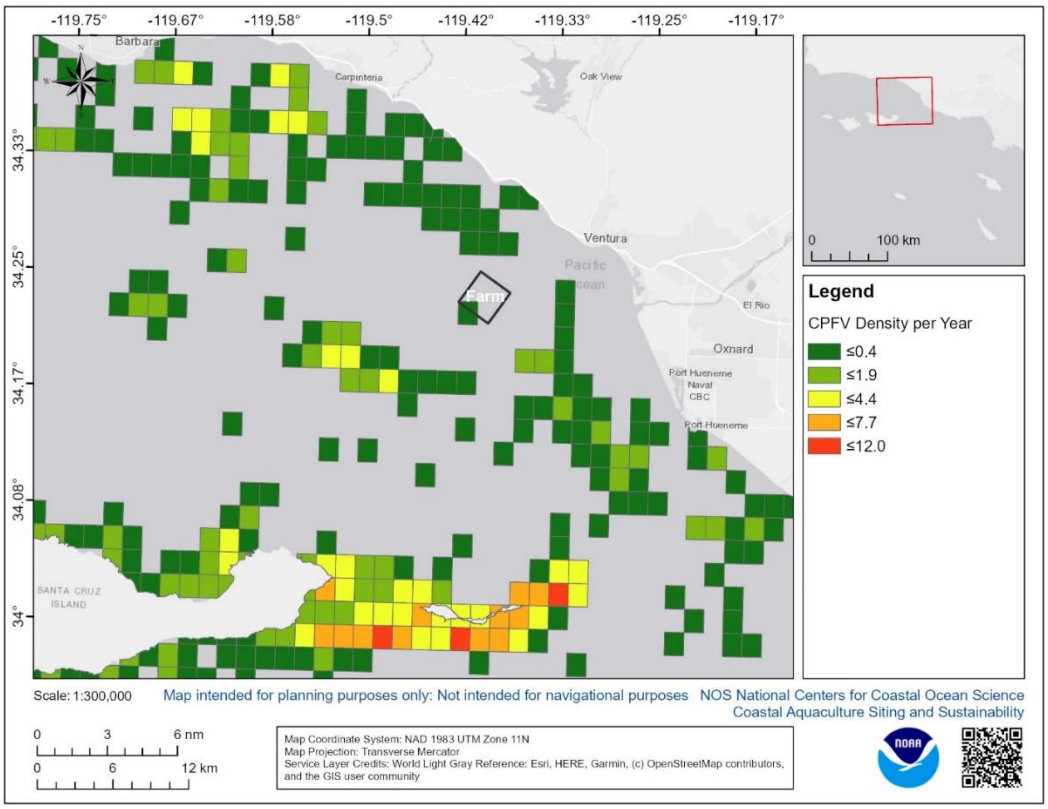

Figure 4-26 CPFV vessel average density per year 2010 – 2019.

CDFW California Recreational Fisheries Survey (CRFS) private vessel data comprised of dockside surveys recorded at the microblock (1 nm) and block (10 nm) resolution. The surveys represent a subsection of the total recreational fishing effort are conducted at the public docks and by phone to licensed anglers to provide an overall representation of recreational fishing activity, where the respondents are presented with a map of the area and asked where they fished. All microblock data was extracted to create a total count per month for each microblock. Figure 4-27 below shows average number of vessels per year per 1 nm microblock. The area near Channel Island has the highest concentration of recreational fishing. There is no significant activity recorded near the project site.

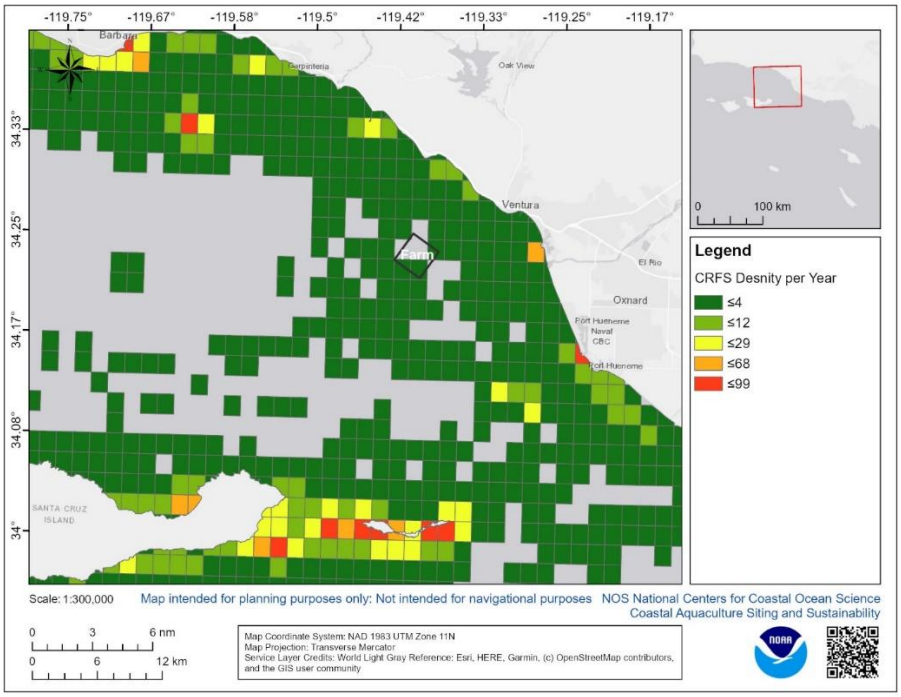

Figure 4-27 CRFS average number of vessels per year per 1 nm microblock 2010 – 2019.

5 Navigation Risk

5.1 Framework and process

The purpose of the Navigation Safety Risk Assessment (NSRA) is to identify navigation risks associated with the presence of the VSE project. This is followed by an evaluation of the risk considering risk reducing measures already in place. Risks will be evaluated qualitatively with a ranking of "Low", "Medium" or "High" based on the combined consideration of likelihood and consequence. Finally, additional risk reducing measures may be suggested if it is considered necessary or relevant to reduce the risk further.

Prior to initiating this study, the NOAA CASS team performed a siting analysis to determine the optimal location of the VSE project [15]. Navigation risks were considered, as well as other impacts such as marine life, naval and oil/gas interference, see Appendix A Figure 7-1. Overall, the location was chosen to minimize the impacts within the boundaries of a 20,000 acre area that had been initially designated as potentially suitable for aquaculture.

Commercial vessel traffic that passes through the TSS has, in this study, been distinguished from traffic that navigates outside the TSS, which is more local in character. There will be inherent differences is vessel types, sizes and drafts for the two groups that impact the risk evaluation. Vessels associated with the project site (harvest and maintenance) are also identified separately. These categories are defined as follows:

- Local third party traffic: Vessel traffic not inside the TSS (excluding vessels related to the VSE project)
- Commercial traffic in TSS: All vessels following the TSS
- Project vessel: Any vessel associated with the VSE project such as harvest and maintenance

5.2 Hazard Identification

Identification of hazards is based on information and outreach from the VPD and VSE consultants and volunteers, public comments received during project outreach and the USACE permitting process, and experience from other offshore aquaculture and wind projects. Hazards were discussed with the project team including the Ventura Harbor Harbormaster on March 7, 2020 as well as presented to USCG on April 13, 2020.

The following hazard categories have been identified:

- Vessel entanglement during normal aquaculture farm operation
- Vessel entanglement with disrupted aquaculture farm
- Vessel Collision & Grounding
- Other impacts

Specific hazards and risk reducing measures that are already planned or in place are identified for each hazard category.

5.2.1 Vessel entanglement during normal aquaculture farm operation

The hazards identified under this category focus on entanglement scenarios where the aquaculture farm and associated gear are operating normally without any broken lines, connections, or improper anchoring. The identified risks along with risk reducing design features already incorporated into the project are described in Table 5-1.

Table 5-1 Hazard identification for entanglement scenarios without equipment failure

Risk No	Hazard	Potential consequence	Risk reducing measures in place	Risk level
1.1	Local third party vessel intentionally entering the project site becomes entangled with aquaculture equipment	Casualties/ equipment damage	> System submerged 15ft below surface and vessel draft generally < 15ft > Trawling and fishing below 15ft prohibited inside farm > Surface buoys in tension and reflectors on corner buoys > Notice to mariners during construction activity	See Chapter 5.3.1
1.2	Local Third party vessel becomes entangled when unintentionally entering the project site	Casualties/ equipment damage	> System submerged 15ft below surface and vessel draft generally < 15ft > Limited traffic in vicinity of the farm. > Aids to Navigation (updated navigation chart, corner buoys with radar and AIS)	See Chapter 5.3.1
1.3	Commercial vessels from TSS drift into farm and becomes entangled with aquaculture equipment	Equipment or boat damage	> Distance from TSS route to site is 6nm > Current direction is favorable > Aids to Navigation (updated navigation chart, corner buoys with radar and AIS)	See Chapter 5.3.1

The risk level for each of the identified hazard is evaluated in further detail in Chapter 5.3.

5.2.2 Detached aquaculture farm elements

This chapter covers hazards identified in the situation where aquaculture equipment detaches partially or fully. This could range from a buoy being disconnected from its rope to an event where entire longlines or anchor lines break loose and drift or anchors become unmoored. It is important to distinguish between equipment is fully detached and able to drift away and where it is only partially detached and still connected to the longlines or seabed. The consequences of vessel entanglement are also expected to be largely dependent by the vessel size and speed. The identified scenarios are listed in Table 5-2, together with potential consequences and risk reducing design features already incorporated into the project.

Table 5-2 Entanglement hazards with detached aquaculture equipment

Risk No	Hazard	Consequence	Risk reducing measures in place	Risk level
2.1	Vessel entanglement with partially detached aquaculture equipment (lines, ropes etc.)	Worst case capsizing with casualties Vessel damage Aquaculture farm damage	> Aquaculture system permit design engineered to withstand 100-year storm > Sinking ropes to be used for surface buoy lines and other lines where rope slack may occur > Gear management plan, which includes monitoring equipment twice a month with immediate repairs > Routine patrol by Ventura Harbor Patrol to ensure aquaculture farms properly maintained > Decommissioning plan requiring removal of all aquaculture gear upon termination or expiration of authorization	See Chapter 5.3.2
2.2	Vessel entanglement from fully detached and drifting aquaculture equipment (lines, ropes etc.)	Aquaculture farm damage Limited vessel damage (propeller)	> Aquaculture system permit design engineered to withstand 100-year storm > Sinking ropes to be used for surface buoy lines	See Chapter 5.3.2

		Potential loss of steering power	> Gear management plan, which includes monitoring equipment twice a month with immediate repairs > Routine patrol by Ventura Harbor Patrol to ensure aquaculture farms properly maintained > Decommissioning plan requiring removal of all aquaculture gear upon termination or expiration of authorization	

Both hazards are discussed further in Chapter 5.3.

5.2.3 Collision & Grounding

Collision between two vessels may occur as an indirect consequence of the presence of the VSE project. In addition, new vessel traffic associated with harvest and maintenance vessels (referred to as project vessels) will start when the farm is installed. Hazards related to collisions involving third party vessels and/or project vessels are identified in Table 5-3.

Table 5-3 Hazards related to collisions and grounding

Risk No	Hazard	Consequence	Risk reducing measures in place	Risk level
3.1	Project Vessel Collision with third party vessel	Vessel damage, environmental impact (oil spill)	> Project vessels will generally only operate at daylight	See Chapter 5.3.3
3.2	Project vessel collision with project vessel	Vessel damage, environmental impact (oil spill)	> Project vessels will generally only operate at daylight	See Chapter 5.3.3
3.3	Collision between two third party vessels	Vessel damage, environmental impact (oil spill)	> Limited vessel traffic near farm > Limited rerouting necessary > Updated navigation charts	See Chapter 5.3.3

3.4	Vessel groundings caused by aquaculture farm	Vessel damage, environmental impact (oil spill)	> Aquaculture farm located with limited impact to existing vessel traffic. > Sufficient water depth for vessels going around the farm	**Not considered further**

Risk 3.1-3.3 are discussed and evaluated further in Chapter 5.3. The risk of groundings caused by the presence of the project (Risk No 3.4) is not considered relevant for this project. There is sufficient water depth around the project site and no significant vessel traffic routes travel through the site. Nearly all vessels in the area have drafts less than 15ft, which make it possible to pass on either side of the farm without grounding. Finally, the historical accident data review presented in Chapter 4.2 showed no incident of groundings near the farm.

5.2.4 Other navigation impacts or hazards

Other navigation impacts or hazards are identified based on input from the VSE project consultants and volunteers, project outreach, and experience from other offshore aquaculture and wind farm projects. These impacts include:

- Radar interference
- Impact to fishing areas

A typical concern for offshore installations is the potential for radar interference. This can be a concern when the physical extent of the structure creates the possibility of a shadowing effect or the number of physical structures can create a clutter or saturation effect on the radar images. However, the only visible object at the project site are surface buoys with a 16-inch diameter. Corner buoys are equipped with radar reflectors and AIS transmitter but are generally not expected to cause shadowing or other significant adverse radar interference.

A general overview of fishing activities is discussed in Chapter 4.3.10. Generally, while some commercial fishing occurs in the area, the amount of fishing near the project site is not significant as compared to other areas in the region, with the exception of one area used for market squid fishing near the northern boundary of the project area.

Navigation risks related to fishing vessels is covered in previous chapters where fishing vessels are considered part of "third party vessels" similar to passenger vessels and recreational vessels. The extent to which fishing areas will be affected without posing a navigational risk is not part of the scope for this navigation risk assessment.

5.3 Risk Evaluation

The following chapter evaluates the risks identified in the previous chapter based on information presented in Chapter 4 and the mitigation measures incorporated into the project plans and permit design.

5.3.1 Vessel entanglement during normal aquaculture farm operation

Three different entanglement hazards are identified. Each of these are evaluated below.

Risk No 1.1 ***Local third party vessel <u>intentionally</u> entering the project site becomes entangled with aquaculture equipment***

Description

The VSE project currently does not propose to prohibit vessels from being inside the boundaries of the project site. There is therefore a risk that a vessel, which intentionally enters the project site area, becomes entangled in ropes or equipment associated with the aquaculture farm. This scenario considers the situation where the farm is operating normally with all lines, equipment, and anchors properly attached. The alternate scenario where gear has detached or broken loose is discussed in the following chapter.

Evaluation

Almost all vessel traffic that currently navigates in the area near the farm has a draft less than 15ft. Further, with proper location identification of the farm on navigational charts and PATON buoys, which are already proposed as part of the project, it is considered unlikely that vessels with a draft of 15 ft or more will intentionally enter the project site. In 2017, only 382 vessel transits with AIS data were made through the project site. AIS data is likely to be fairly representative of the overall vessel traffic near the project site because it is several miles from shore and most vessels passing near the project site are likely in transit to a location further offshore, in which case the most would be expected to carry AIS. A few additional fishing vessels without AIS may also visit the area. Vessels transiting in a north/south direction may in the future choose to navigate around the project site. The detour would add a maximum of 1-2 nm to the trip and may be simpler and safer than navigation through the surface buoys located approx. 150 ft apart (see Figure 3-2).

The VSE project has been designed so that the vast majority of the aquaculture equipment will be submerged at least 15ft below the water surface at all times, see Chapter 3.1. Only the surface buoys and the ropes connecting the buoys to the longlines will not be submerged. However, the permit design of the surface buoys keeps them in tension during normal operations throughout all tidal variation. To further minimize entanglement potential, a 1,100 pound breakaway link will be installed between the surface buoys and vertical lines. Finally, the physical extent of the surface buoys, 16 inches in diameter, combined with the tension in the ropes, will likely provide a shielding effect from entanglement and vessels will likely glance off instead. The impact of the surface buoys alone will likely present no greater navigation challenges to vessel that a typical trap fishery, where surface buoys are used.

In certain extreme storm conditions, anchor lines may become slack with the potential to drift upwards and be less than 15 ft submerged. To mitigate this situation, shellfish growers will be required to use sinking rope for all anchor lines avoid lines floating to the surface. This design feature will prevent slack lines from surfacing under extreme storm conditions. Based upon communications with the project team, it is also expected that the project's gear monitoring and management plan will identify any slack lines or lines that have broken loose, to further reduce the risk of entanglement.

Risk level

Based on the available information, the risk of entanglement to vessels that intentionally enter the farm the risk is evaluated as *low*. This conclusion is based on the assumption that vessels with a draft of 15 ft or more will not intentionally enter the farm and the project design requirements reduce the likelihood and consequence of entanglement.

Risk No 1.2

Local third party vessels become entangled when unintentionally entering the project site

Description

Based upon AIS data, there is a low amount of vessel traffic both around and through the project site. If a vessel enters the project site unintentionally due to meteorological conditions, mechanical and/or human error, there is a risk of entanglement. This could lead to equipment damage, vessel damage and, in a worst-case scenario, casualty.

Evaluation

The traffic volume near the project site was 1026 passages in 2017 based upon AIS data. The majority of the vessel traffic was located west of the project site and consisted mostly of passenger vessels, pleasure craft, fishing and offshore supply vessels. These vessels are generally small with a length of less than 100 ft and a draft less than 15 ft. Thus, if they unintentionally enter the farm, they should be able to pass or drift over the aquaculture farm without entanglement with the longlines and anchor lines. As mentioned for Risk 1.1, the surface buoys and rope connections to the longlines are designed to be in tension during all tidal variations. This will make entanglement less likely and lead to vessels glancing off the buoys instead. To further minimize entanglement potential, a 1,100 pound breakaway link will be installed between the surface buoys and vertical lines. The scenario of detached lines is considered separately under Risk 2.1 and 2.2.

Entanglement with the surface buoys could happen both from drifting vessels and power-driven vessels. The project site will be marked on the navigation chart and each farm area will be marked by navigational buoys marking each corner with appropriate lighting, radar reflectors, AIS, etc. The probability of power-driven vessels unintentionally entering the farm is therefore considered low.

A few specific offshore supply vessels were identified with a draft of more than 15 ft, regularly passing a few miles west of the farm. Additionally, as per Figure 4-24, trawling activity identified by VMS data shows a relatively small amount of activity in the vicinity of the project site. Overall, very few vessels are considered to pose a threat for entanglement with the majority of aquaculture gear designed to be located below 15 ft water depth. Vessels with a draft above 15 ft generally travel a

few miles away from the project site and should naturally steer clear of the farm and not be enter inside the perimeter.

The consequence of entanglement is expected to be largely dependent on the size of the vessel and the vessel speed. In drifting situations, entanglement could lead to damage to the aquaculture farm or ship but the worst-case consequence of the vessel capsizing is mostly if not fully mitigated by the low drifting speed.

Risk level

Considering both the low likelihood of vessels unintentionally drifting or navigating into the farm area as well as the consequence that are largely mitigated by submerging the aquaculture farm and having the surface buoys in tension, the overall risk level for this scenario is considered low.

Risk No 1.3 ***Commercial vessels from TSS drift into farm***

Description

While the TSS is located far from the project site, there is a risk that vessels can, in the case of engine blackout, drift towards the project area without being able to regain engine power and/or steering.

Evaluation

Vessels navigating along the TSS are at least 6 nm from the project site and the TSS is not oriented towards the project area. Thus, the project should not affect safe navigation of vessels along the TSS.

As described in, Chapter 4.3 Table 4-6, roughly 3600 vessels pass along the TSS every year. The majority of these vessels are large, above 500 ft in length with a typical draft between 30-50 ft.

The likelihood of vessels drifting into the project site can be roughly estimated based on published literature regarding vessel blackouts and drifting vessels as applied to local conditions and vessel traffic. The likelihood of a blackout is assumed to be 2.5E-4 per hour [16]. Based upon a 10 nm stretch of the TSS and a conservative low speed of 10 knots, and 3591 yearly passages (Area E) in the considered area, it is estimated that there would be one blackout annually.

The direction that a vessel will drift in case of a blackout is determined primarily by its original course and the wind and current direction. The wind and current directions are described in chapter 4.1. The prevailing wind direction comes from the west and the current being along the direction of the TSS in a Southeastern or Northwestern direction. This means that in some situations a drifting vessel may drift towards the project site in the eastern direction.

In an inertia stop, a vessel will reach a drifting speed at a distance of approximately 34L, where L is the length of the ship [17]. This means that during a blackout situation a vessel, with a length between 500 – 1000 ft, the vessel will reach a drifting speed after a distance of approx. 2.75 – 5.5 nm. Based on this, it would take approx. one hour for a vessel to slow down and reach a drifting speed of maximum 2 knots. Using the above assumptions, a drifting vessel would take approximately 2 hours to reach to project area. Studies have shown that the probability of no repair during blackout follow the exponential curve depicted in Figure 5-1 below [16]. After 2 hours there is approximately 30% chance of no

repair and consequently 70% chance of repair. Similarly, there is also a significant chance that the vessel is able to anchor before reaching the area to avoid collision with aquaculture equipment.

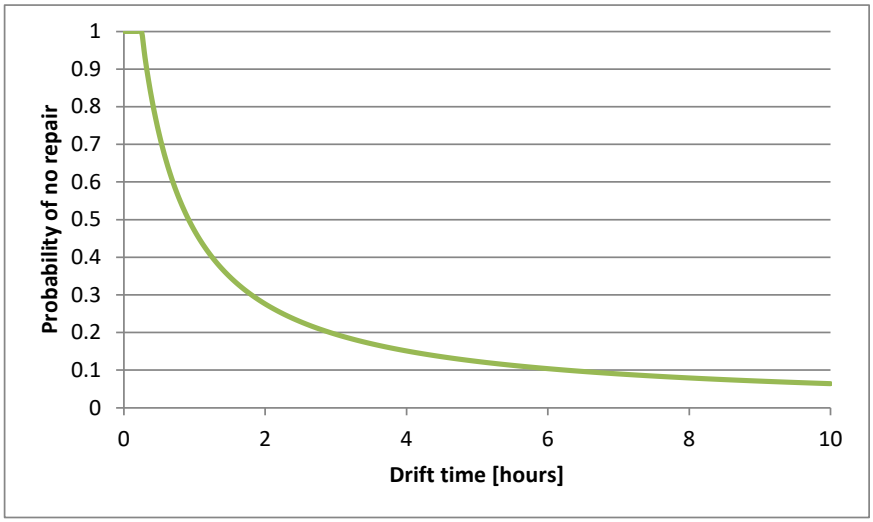

Figure 5-1 Probability of repair vs drifting time [16]

Combining all the above factors, including frequency of blackouts, distance, speed, and possibility of repair, the probability of a drifting vessel reaching the project site is expected to be in the order of magnitude of 1 every 100 years.

The consequence of such an event on the project would likely be most severe as the vessel strength and energy would be able to break lines and pull up anchors. The consequence for these larger vessels is likely to be minimal, as the drifting vessel will likely not be interrupted by collision with the aquaculture equipment, and therefore this is primarily seen as a risk to the project rather than a risk for the general public.

Risk level

Based on a consideration of the both likelihood and consequence (to third parties) of vessels drifting from the TSS into the project site, the overall risk is considered *low* and, given the very low probability of occurrence, additional mitigation measures are not considered necessary to reduce this risk further.

5.3.2 Detached aquaculture farm elements

Risk 2.1 ***Vessel entanglement with partially detached aquaculture equipment***

Description:

If a rope partially detaches or a buoy breaks, leaving exposed slack rope that is still connected to the longlines or anchor lines, there is a risk of entanglement. In a worst-case scenario, this could lead to vessel capsizing with casualties.

Evaluation

The project permit design has been engineered to withstand a 100-year storm condition. This reduces the likelihood of broken connections and loose rope significantly, and the combined likelihood of damage to equipment and a vessel entering the project site during a 100-year storm together is even less likely.

However, accidental impact from marine life or vessels may damage the aquaculture farm elements and lead to a dangerous situation.

The risk of entanglement associated with broken connections at the surface buoys is mitigated using sinking ropes that will drop towards the seabed instead of regular ropes that would float to the surface. The sinking rope will sink below the connection point with the longline and therefore be at least 15 ft below the water surface. As part of the project's proposed gear management plan, aquaculture equipment will be inspected twice per month and any identified damage must be repaired immediately. The plan also requires inspections after a large storm event once conditions become safe.

When comparing the permit design and planned operational procedures for the VSE aquaculture farm to the actual operations at the CSR project, there are significant differences in the approach that would mitigate against and prevent an accident like that which occurred at the CSR facility (see Chapter 4.2). Mitigation factors that VSE have undertaken or committed to undertake that would seek to prevent such an accident are well described through this report. While entanglement risk cannot be completely eliminated, the risk reducing measures incorporated into the project design provide a robust design to minimize these risks.

Risk level

Based on the operational requirements discussed above, the risk of entanglement from detached buoys or loose ropes is mitigated to a degree where the risk of entanglement with severe consequence is considered *low*. Additional mitigation measures recommended to reduce the risk even further are presented in Chapter 5.5.

Risk No 2.2

Vessel entanglement from fully detached and drifting aquaculture equipment

Description:

If sections of ropes or longlines accidentally break loose and start to drift away from the project site there is a risk of entanglement with vessels passing outside the project site.

Evaluation:

As described in Chapter 3, the aquaculture farm permit design has been engineered to withstand a 100-year storm. This means that it is very unlikely that environmental conditions will cause anchor-lines and longlines to break loose and drift away. Similar to the previous risk, accidental impact from marine life or vessels may also cause aquaculture equipment to break loose. The consequence will depend on what equipment breaks loose.

The surface buoys are in themselves not considered a danger to any passing vessel. Since the buoy connection will use sinking ropes, they will drop to the seabed and be outside any immediate risk and will be collected as part of routine gear maintenance. The anchor ropes and longlines are not required to be sinking and they can potentially drift if detached from the anchors; however, they will be weighed down by the growing mussel socks to which they are connected, meaning that they will likely sink to the bottom. In the event that lines or ropes are

disconnected, they may become entangled with vessels but because the ropes are loose, the consequence would likely be limited to vessel and propeller damage and would not represent an immediate risk of capsizing or casualties. In the event of propeller damage to a third party vessel away from the project site, the vessel would be in a similar circumstance to any other vessel that becomes immobilized while on the water due to other reasons, such as engine failure, fuel depletion etc. Ventura Harbor Patrol and USCG can respond to distress or emergency calls in this circumstance.

The risk of aquaculture equipment breaking free and escaping the project site has been minimized through the same project design features discussed under Risk 2.1 above.

Risk Level

Based on the operational requirements discussed above, the risk from entanglement with fully detached and drifting aquaculture farm elements is considered *low*.

5.3.3 Collision & Grounding

Risk No 3.1 ***Project vessel collision with third party vessel***

Description

Project vessels are expected to travel to and from Ventura Harbor and the project site on a daily basis once the project has been installed. Thus, there is a risk of collision between third party vessels and the project vessels either at the entry/exit at Ventura Harbor or in the corridor between the Harbor and the project site. In the event of a collision, consequences may include material damage to the vessels with the potential of an oil spill.

Evaluation

Once the project is fully installed and operational it is expected that an average of 8-16 project vessels will travel to and from the site each day, resulting in approximately 3,000-6,000 round trips per year, as described in Chapter 3.2. Project vessels will generally only travel to and from the project site during daylight hours, which means that the vessels are likely able to maintain a proper look-out as compared to navigating during night.

A limited number of local third party vessels navigate east of the project site in a corridor between the project site and the shoreline; see Route 1 in Chapter 4.3.3. The width of this corridor between the project site and the shoreline is about 3.5 nm. Based on 2017 AIS data, there were 447 voyages though this corridor, with the majority of the voyages being small passenger and recreational vessels, followed by oil recovery and offshore supply vessels. In addition, a significant number of vessels enter/exit Ventura Harbor every day. While 5306 vessel entries or exits were recorded from AIS data in 2017, a substantial amount of vessels entered and exited the Harbor without AIS, as further outlined in Chapter 4.3.9.

The risk of collision between a project vessel and a third party vessel is evaluated considering the likelihood that two vessels meet or cross outside the Harbor and that at least one vessel fails to take an effective action to avoid collision. The

likelihood of this occurring is estimated using the combination of the following input parameters:

- Causation probability: it is the probability of a vessel being aberrant or failing to correct to a safe course when on a collision course with another vessel. Various studies provide estimates for the causation probability – often in relation to ship-ship collision or ship allisions with bridges. Frequently used referenced studies are published by Fujii et al. and by Macduff, which document a causation probability ranging between 1.0 to 6.3 x 10^{-4} per vessel passage [18].
- Total number of yearly voyages of the third party vessels through the specified navigation corridor
- Yearly trips of project vessels to/from project site
- Project and third party vessels dimensions and speed
- Geometrical probability of a project vessel and a third party vessel being on a collision course

Using the conservative estimates for the above mentioned parameters, the risk of collision between the between third party vessels and project vessels is evaluated to be in the order of magnitude between 1 in every 100 to 1000 years.

The risk related to project vessels entering and leaving Ventura Harbor was addressed previously in a letter to USACE. The total passages in or out of Ventura Harbor can be as high as to 450 per day during exceptional peak season conditions and 100 per day during off-peak season. The 8-16 additional vessel passages from project vessels does not constitute a very large increase to existing vessel traffic. Thus, Ventura Harbor can likely accommodate this vessel increase without compromising navigation safety into and out of the Harbor.

Risk level

Given the small volume of vessel traffic navigating in the corridor that project vessels will use, the likelihood of collision is considered *low*. However, cost efficient mitigation measures may be considered to reduce the risk even further; see Chapter 5.5.

Risk No 3.2 ***Project vessel collision with project vessel***

Description

Multiple project vessels will navigate daily to and from the project site and Ventura Harbor, a distance of approximately 4-5nm. Thus, there is a risk that two project vessels may collide with each other when navigating towards each other.

Evaluation

Project vessels are expected to conduct an average 8-16 total daily visits to the project site (16-32 one-way trips). On a yearly basis, this would result in approximately 3,000-6,000 return trips to and from the farm. Project vessels are expected to have a length of approximately 25 to 40 feet.

When evaluating the risk level of collision, the following factors are considered:

- It will take approximately half an hour for project vessels to reach to the project site, with an average speed of 10 knots. Therefore, the time that each vessel will navigate between the project time and the Harbor is short.

- The likelihood of two project vessels using the same route at the same time is low, particularly when navigating on a reciprocal course.
- Project vessels are expected to visit the farm only during the daytime when vessels are likely able to maintain proper lookout as compared to navigating during the night time.

Risk level

The likelihood of collision between two project vessels is considered *low* primarily based on the limited traffic, the short distance to the project site, and project operations being limited to daytime hours. Similar to Risk 3.1, additional risk reducing measures may still be considered and are presented in Chapter 5.5

Risk No 3.3 ***Collision between two third party vessels***

Description

Collisions between two vessels are a known phenomenon. The likelihood of such collisions may be affected when introducing a new object, such as the project, in a navigable waterway. This may cause vessels to be rerouted to other paths and thereby increase the vessel density and the likelihood of collision.

Evaluation

Based upon the vessel traffic analysis, approximately 151 vessels passed through the project site in 2017. These were generally passenger boats, recreational boats and fishing. When the project is installed, some of these vessels might decide to pass around the project site instead of going through. This marginally increases the likelihood of ship to ship collisions. However, with the limited traffic near the project site, this marginal increase is not considered to result in an overall increase to the risk of collisions in the area. Based upon 2017 AIS data, one vessel will currently transit through the project site every 2.4 days and therefore the chance of two vessels making the same course alteration at the same time is extremely small. That is not to say that collisions of third party vessels in the vicinity of the project site is not possible, but that the chance that they are caused by the presence of the project is negligible.

Risk Level

Because the amount of potentially rerouted vessels and the traffic around the project site is already very limited, any slight increase in ship to ship collisions is considered *negligible*.

5.4 Risk Summary

A summary of the risk evaluation for the hazards presented in Chapter 5.2 is presented in Table 5-4. All risks are evaluated as being either "low" or "negligible".

Table 5-4 Summary of risk evaluation for the identified hazards.

Risk No	Hazard	Risk level
1.1	Local third party vessel *intentionally* entering the project site becomes entangled with aquaculture equipment	Low

1.2	Local third party vessels become entangled when unintentionally entering the project site	Low
1.3	Commercial vessels from TSS drift into farm	Low
2.1	Vessel entanglement with partially detached aquaculture equipment (lines, ropes etc.)	Low
2.2	Vessel entanglement from fully detached and drifting aquaculture equipment (lines, ropes etc.)	Low
3.1	Collision between project vessel and third party vessel	Low
3.2	Project vessel collision with third party vessel	Low
3.3	Project vessel collision with project vessel	Negligible
3.4	Collision between two third party vessels	Negligible

5.5 Additional mitigation measures

It was found that, upon incorporation of risk reducing measures and project design features, all the identified risks as a result of the project are already mitigated to a level where the risk were low or negligible. However, in certain situations, simple cost-efficient mitigation may be considered to further reduce the risks. These are generally recommended. Risk reducing measures to be considered are:

- **Speed restriction**: One way to lower the potential consequence from entanglement (see risks 1.1, 1.2 and 2.1) is by imposing a speed restriction for vessels who are inside project site. A reduced speed would presumably reduce the likelihood of capsizing in case of entanglement with the ropes.
- **Exclusion Zone:** A more extensive measure that would further reduce the risk of entanglement from vessels intentionally entering the project site (risk 1.1) is to prohibit third party vessel traffic unrelated to project construction and operation inside the project site. However, these conditions will not eliminate the risk of entanglement from vessels unintentionally entering the project site. Implementation of these restrictions should be determined in coordination with the USCG.
- **AIS on project vessels:** It is recommended that VSE project vessels be equipped with AIS transponders that are able to both relay and receive information. This would reduce the likelihood of collisions even further, see Risk 3.1 and 3.2.

- **Communication to the local maritime community:** It is highly recommended that the Ventura Harbor Patrol and local mariners be informed about the project and associated operational activities so that everyone navigating in the area is fully aware of the fact that they might encounter vessels associated with the project. This process has already started through the outreach program, but it is important to continue sharing relevant information that may affect navigation in the area.

6 Conclusions

With the introduction on any offshore installation, that being a wind farm, oil platform or aquaculture, a certain increase in navigation risk is inevitable. However, based on the evaluation of the identified risks for this project, it was determined that the navigation risk level associated with the VSE project is low.

The historic accident statistics from the area document several incidents per year of varying severity. The increase in risk of accidents caused by the presence of project is not expected to be significant.

Considering all the identified risks, there were two general topics that were of most concern:

- Vessel entanglement with aquaculture equipment (risk 1.1, 1.2, 1.3, 2.1 and 2.2)
- Ship to ship collisions involving project vessels (risk 3.1 and 3.2).

Subchapters 6.1 and 6.2 below outlines the conclusions for each of the above risks, along with any additional risk reducing measures to be considered.

6.1 Vessel Entanglement with aquaculture ropes

The risk of a local third party vessel entangling with the aquaculture equipment can, in a worst-case scenario, result in capsizing and potential casualties. It was concluded that this risk has been mitigated to a large extent through the following measures:

- The farm will be marked on the navigation chart and all major equipment associated with the aquaculture will be submerged at least 15ft below the waterline, with the surface buoys being the only exception. The surface buoys will be in tension throughout all tidal and marine conditions and therefore no slack lines shall be on the surface. The surface buoys shall also provide visual identification of the area. To further minimize entanglement potential, a 1,100 pound breakaway link will be installed between the surface buoys and vertical lines.
- The project permit design has been engineered to withstand a 100-year storm, thus minimizing the risk of broken lines or equipment that would pose a risk of entanglement.
- Sinking ropes shall be used for the connection to the surface buoys as well as other equipment that may be slack under certain conditions or not able to withstand a 100-year storm. In the event that any of the equipment breaks loose during a storm or from an accidental impact, it is unlikely that it will float to the surface.
- The project has incorporated an aquaculture gear monitoring and management plan that requires inspections of aquaculture gear twice per month with immediate repair or replacement to any damaged equipment.

The risk can be mitigated further by introducing additional measures. A speed restriction for vessels inside the project site, if deemed practical, is recommended, as it will reduce the consequence in the unlikely event that any entanglement does occur. More extreme measures that could be considered would be the introduction of an exclusion zone, prohibiting third party vessels from being within the project site. This type of restriction is often adopted for other offshore installations such as oil platforms and wind farms. The decision regarding such a measure and how to enforce it should be agreed upon between VPD and the USCG

6.2 Ship-ship collisions involving project vessels

Risks relating to ship to ship collisions focuses on the potential increased risk resulting from introducing harvest and maintenance vessels (project vessels) going to and from the project site and Ventura Harbor on a daily basis. The increase in vessel traffic in and out of Ventura Harbor has already been addressed in a response to USACE and is generally not considered to constitute a significant increase risk beyond what can be safely handled by the Harbor.

In addition, the risk of collisions during transit to the project site, either between two project vessels or a project vessel and a third party vessel, was found to be low, considering the limited traffic in the area and the short transit time. Furthermore, project vessels will normally only operate during daylight when visibility is best.

In order to further reduce the risk of collisions involving project vessels, it is recommended that all project vessels be required to be equipped with AIS transponders. Finally, it is recommended that the local maritime community in Ventura Harbor and nearby harbors continue to be informed about the project development, installation and operation, as well as any increased awareness this might require when passing near the project site.

7 References

[1] NOAA, "US Coast Pilot 7, Pacific Coast: California, Oregon, Washington, Hawaii and Pacific Islands".

[2] "National Data Buoy Center," [Online]. Available: https://www.ndbc.noaa.gov/station_history.php?station=46053.

[3] "Southern California Coastal Ocean Observing System, ROMS Model Output," [Online]. Available: https://sccoos.org/roms-model-output/.

[4] NOAA, "Data Tools: Local Climatological Data (LCD)," [Online]. Available: https://www.ncdc.noaa.gov/cdo-web/datatools/lcd.

[5] NOAA, "National Weather Services, Boating in Fog," [Online]. Available: https://www.weather.gov/safety/fog-boating.

[6] NOAA, "Santa Barbara, California 1/3 arc-second MHW Coastal Digital Elevation Model," [Online]. Available: https://www.ncei.noaa.gov/metadata/geoportal/rest/metadata/item/gov.noaa.ngdc.mgg.dem:603/html.

[7] NOAA, "Santa Barbara, CA - Station ID: 9411340," [Online]. Available: https://tidesandcurrents.noaa.gov/stationhome.html?id=9411340.

[8] USCG, "Marine Information for Safety and Law Enforcement (MISLE)," U.S. Coast Guard.

[9] O. C. S. Department, "Vessel Accident Report 19-000290," 2019.

[10] United States Coast Guard, "AIS REQUIREMENTS," [Online]. Available: https://www.navcen.uscg.gov/?pageName=AISRequirementsRev.

[11] United States Coast Guard, "U.S. COAST GUARD NAVIGATION CENTER," [Online]. Available: https://www.navcen.uscg.gov/.

[12] MarineCadastre.gov, "Vessel Traffic Data," [Online]. Available: https://marinecadastre.gov/ais/.

[13] NOAA, "Tutorial: AIS Track Builder," [Online]. Available: https://coast.noaa.gov/data/marinecadastre/ais/TrackBuilderTutorial.pdf.

[14] NOAA, "Tutorial: How to build Vessel Density Maps with AIS," [Online]. Available: https://coast.noaa.gov/data/marinecadastre/ais/Tutorial_How_to_Build_Vessel_Density_Maps_with_AIS_OCM508.pdf.

[15] NOAA, "Ventura Shellfish Enterprise: Aquaculture Siting Analysis Results," National Oceanic and Atmospehric Adminstration, NOAA, 2018.

[16] Germanischer Lloyd, "Offshore Windparks – Parameter für Risikoanalysen im Genehmigungsverfahren und Wirksamkeit kollisionsverhindernder Maßnahmen, Rapportnummer SO-ER 2010.095, Version 1.0.," 2010.

[17] ShipsNow, "Measures and Criteria of Manoeurability," [Online]. Available: https://shipsnow.com/wiki/measures-and-criteria-of-manoeuvrability/.

[18] "O.D. Larsen, Ship collision with bridges,," IABSE , 1993.

Appendix A Detailed vessel traffic information

Table 7-1 Total Number of voyages in 2017 from all routes within each area by vessel category and classification.

Vessel Category	**Vessel Classification**	**Area**				
		A	**B**	**C**	**D**	**E**
Cargo	Cargo, all ships of this type					19
	Cargo, hazardous category A					10
	Cargo, no additional information					3
	Freight Barge					2
	Freight Ship					2892
	Public Freight					8
Fishing	Commercial Fishing Vessel	35	103	590	23	5
	Fishing		4	21	9	
Not Available	Not available or no ship, default	33	38	38	1	
Other	Industrial Vessel	5	14	279	72	1
	null	28	83	379	16	105
	Offshore Supply Vessel	16	106	108		4
	Oil Recovery	8	115	176	3	1
	Public Vessel, Unclassified	6	11	129	21	31
	Research Vessel	9	15	97	10	4
	School Ship			2		4
	Wing in ground (WIG), hazardous category C		1			
Passenger	Passenger (Inspected)	131	285	2570	3672	38
	Passenger (Uninspected)		2	2		1
	Passenger Barge (Inspected)			3		

Pleasure Craft/Sailing	Pleasure Craft		1	1		2
	Recreational	108	244	904	81	26
Tanker	Tank Ship					329
	Tanker, no additional information					3
Tug Tow	Towing Vessel	3	4	7	1	102
	Towing: length > 200m or breadth > 25m					1
	Total	**382**	**1026**	**5306**	**3909**	**3591**

Table 7-2 AIS 2017 max vessel speed (knots) for vessels within the vessel category by each area.

Vessel Category	**Max Vessel Speed (knots) by Area**				
	A	**B**	**C**	**D**	**E**
Cargo					24.1
Fishing	20.6	20.7	9.9	19.5	10.5
Not Available	10.1	10.2	9.3	9.2	
Other	32.6	31.8	24.7	28	33.5
Passenger	22.2	23.1	20.5	28.3	24
Pleasure Craft/Sailing	39.6	41	17	28	30.8
Tanker					19.2
Tug Tow	11.3	8.1	7.5	8.3	11.9

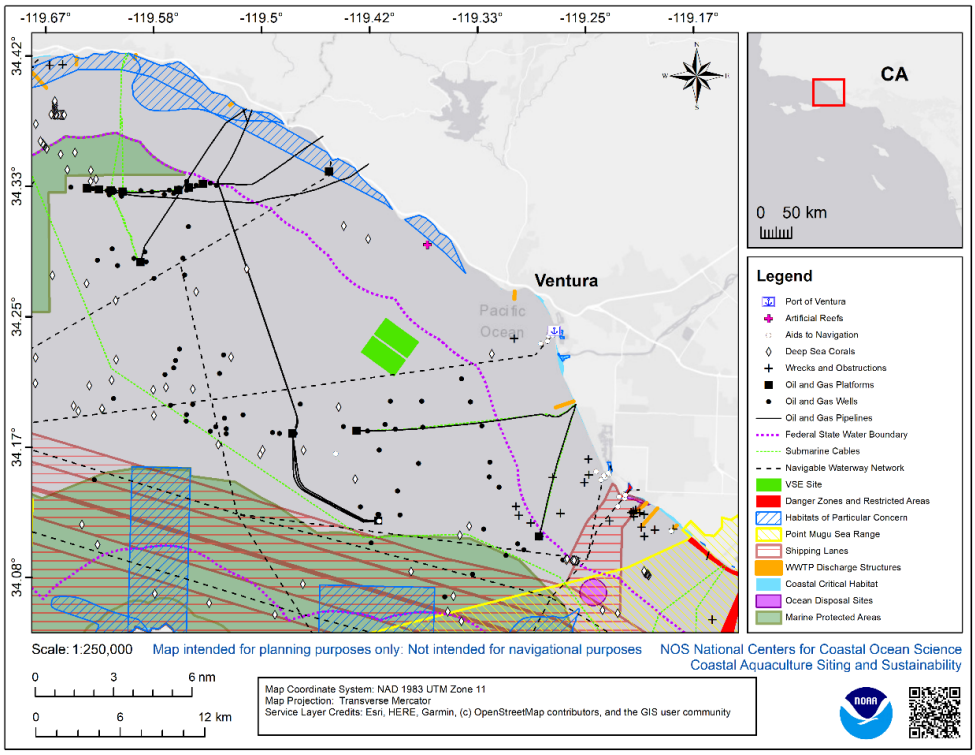

Figure 7-1 Location of aquaculture farm relative to navigation channel, oil and gas platforms, offshore cables and other impacts identified during siting analysis

ATTACHMENT 2

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, LOS ANGELES DISTRICT
60 SOUTH CALIFORNIA STREET, SUITE 201
VENTURA, CALIFORNIA 93001-2598

January 15, 2020

SUBJECT: Request for Resolution to Continue Processing Permit Application

Brian Pendleton
Ventura Port District
Ventura, California 93001

Dear Mr. Pendleton:

This letter concerns your Department of the Army Permit application (Corps File No. SPL-2017-00093-BLR) which proposes to construct a 2,000 acre aquaculture facility in navigable waters outside state boundaries (in Federal waters) in association with the Ventura Shellfish Enterprise Project. The project would be located offshore from the Ventura Harbor, near the city and county of Ventura, CA (latitude: 34.241891, longitude: -119.292983).

In response to our 30 day public notice (dated August 27, 2019) the Corps received a letter from the Ventura County Local Agency Formation Commission (LAFCO) dated September 16, 2019. You provided a response to all the substantive public notice comment letters on November 15, 2019. Within the combined response you included a general response (response B2-1) as well as a separate letter addressing LAFCO's concerns from your special counsel (DeeAnne Gillick, letter dated November 15, 2019). The Corps Regulatory Division Chief (David Castanon), the Ventura team lead (Antal Szijj) and the senior project manager (Theresa Stevens) also met with you, your special counsel (Robert Smith), and your consultant (Laurie Monarres) on November 19, 2019 to discuss the proposed project, remaining issues, and a potential path forward. Prior to this meeting, Dr. Stevens had discussed concerns about issues raised by LAFCO with Ms. Monarres, and stated that review of the matter by Corps Office of Counsel would be requested. Also prior to this meeting, Mr. Smith conducted a phone conference with Corps Staff Counsel (Tiffany Troxel) on October 28, 2019. During this phone conference it was acknowledged that resolution of this matter via the state legislature or state Attorney General may be required.

In response to our public notice, the Corps also received a letter from the U.S. Coast Guard (USCG) dated November 1, 2019, which requested that a navigational risk assessment be completed prior to the Corps final action on the project. Due to the Corps statutory authority under section 10 of the Rivers and Harbors Act (33 U.S.C. 403) to evaluate impacts on navigation associated with structures and work in navigable waters and the recognized expertise of the USCG on navigation issues, the Corps needs at least a draft navigational risk assessment to be completed and submitted to the U.S. Coast Guard. Without this important information documenting the potential impacts to navigation, we cannot complete our required public interest evaluation. Because navigation is central to our review of your application, it would not be a

good use of our limited staff resources to continue processing your application without at least a draft of the navigational risk assessment.

Although you have provided to us the letters, legal opinions and legal citations regarding the claims made by LAFCO, it remains unclear whether the Ventura Port District has the authority under state law to construct permanent structures in navigable waters outside state boundaries as would be required for the proposed Ventura Shellfish Enterprise project.

Therefore, I have made a preliminary determination that in order to continue processing your permit application, the above draft navigational risk assessment and documented resolution of your dispute with LAFCO must be provided. Documentation from LAFCO, the LAFCO Board or a higher level state entity that the dispute has been resolved would be sufficient for the Corps to continue processing your application.

The Corps respectfully requests resolution of these matters in the next 30 days. If the requested information cannot be submitted within 30 days, the Corps will withdraw your permit application. When you do provide the requested information, the Corps will resume review of your previously submitted permit application.

If you have any questions, you may contact me at (805) 585-2148 or aaron.o.allen@usace.army.mil or Theresa Stevens, Ph.D. at (805) 585-2146 or via e-mail at theresa.stevens@usace.army.mil.

Sincerely,

ALLEN.AARON.O.1232270795 Digitally signed by ALLEN.AARON.O.1232270795 Date: 2020.01.15 07:44:28 -08'00'

Aaron O. Allen, Ph.D.
Chief, North Coast Branch
Regulatory Division

Cc: Kai Luoma, Executive Director, Ventura County Local Agency Formation Commission
Lieutenant Commander Isaac Mahar, U.S. Coast Guard District 11 Waterways Management, Los Angeles-Long Beach

ATTACHMENT 2

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, LOS ANGELES DISTRICT
60 SOUTH CALIFORNIA STREET, SUITE 201
VENTURA, CALIFORNIA 93001-2598

February 18, 2020

SUBJECT: Withdrawal of Permit Application

Brian Pendleton
Ventura Port District
Ventura, California 93001

Dear Mr. Pendleton:

I am responding to your application (File No. SPL-2017-00093) for a Department of the Army permit to install structures or conduct work in, over, under or affecting navigable waters of the U.S., in association with the Ventura Shellfish Enterprise project in the Pacific Ocean near the city of Ventura, Ventura County, California.

Our files indicate you have not provided the additional information we requested in our letter dated January 15, 2020 to continue processing your application. Therefore, your application is considered withdrawn. If you wish to re-establish evaluation of your project, please submit the items described in our January 15, 2020 letter.

Thank you for participating in our Regulatory Program. If you have any questions, please contact Theresa Stevens, Ph.D. at (805) 585-2146 or via e-mail at theresa.stevens@usace.army.mil. Please help me to evaluate and improve the regulatory experience for others by completing the customer survey form at http://corpsmapu.usace.army.mil/cm_apex/f?p=regulatory_survey.

Sincerely,

ALLEN.AARON.O.1232270795 Digitally signed by ALLEN.AARON.O.1232270795 Date: 2020.02.13 11:33:19 -08'00'

Aaron O. Allen, Ph.D.
Chief, North Coast Branch
Regulatory Division