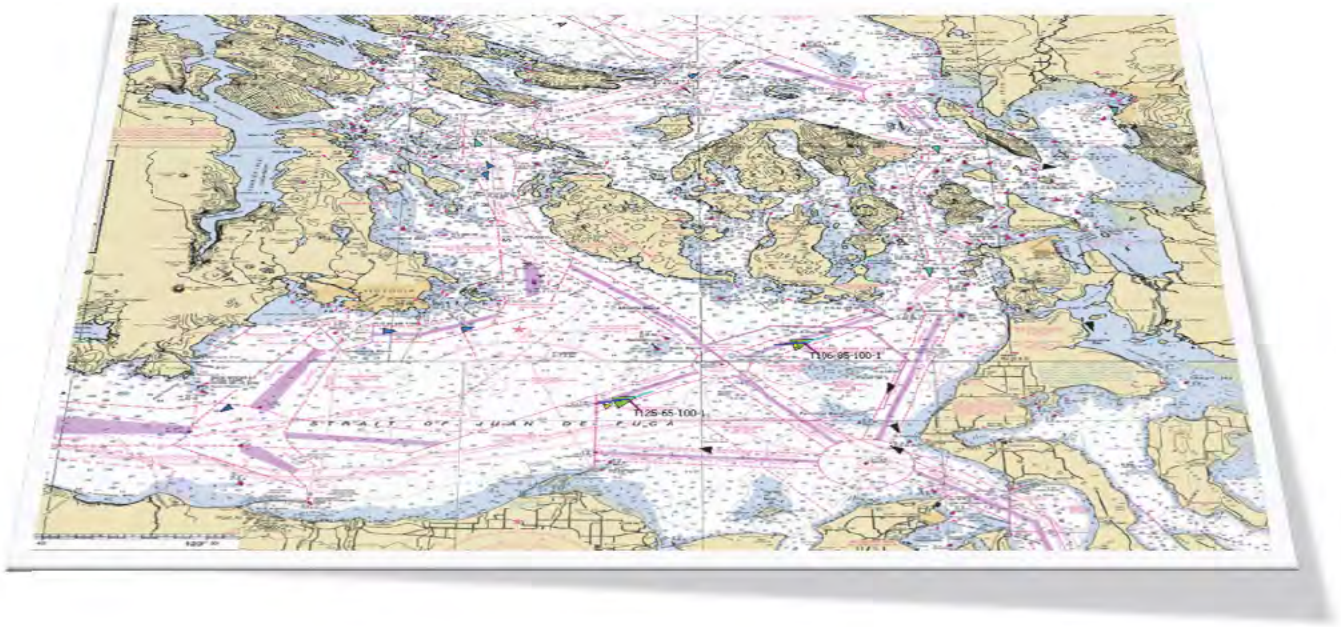
CHAPTER 5

VTRA 2010 FINAL REPORT

Preventing Oil Spills from Large Ships and Barges In Northern Puget Sound & Strait of Juan de Fuca



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5. TRAFFIC PATTERNS AND OIL MOVEMENTS INVTRA 2010 BASE CASE

Running a simulated year 2010 using the methods discussed in Sections 2 and 3, we obtain a comprehensive picture of vessel traffic in the study area. We classify vessel traffic in the VTRA 2010 as focus vessel traffic and non-focus vessel traffic. For focus vessel traffic potential accident frequencies and oil losses shall be evaluated in the remainder of this report. Focus vessel traffic consists of the vessel types: Oil Tankers, ATB's, Chemical Carriers, Bulk Carriers, Container Vessels and a class Other Cargo, capturing other larger cargo vessels. The non-focus vessel traffic is an important modeling aspect of the VTRA 2010 model to evaluate focus vessel collision risk since focus vessels can potentially collide with non-focus vessels[9]. In fact, 75.2% of the total traffic modeled in the 2010 VTRA model is non-focus vessel traffic; the remainder 24.8% is focus vessel traffic. Figure 42 summarizes the focus vessel classification of vessel types in the VTRA 2010 model.

#	VESSEL TYPE	FOCUS VESSEL?	#	VESSEL TYPE	FOCUS VESSEL?
1	BULKCARRIER	CARGO - FV	14	PASSENGERSHIP	NO
2	CHEMICALCARRIER	TANK - FV	15	REFRIGERATEDCARGO	CARGO-FV
3	CONTAINERSHIP	CARGO - FV	16	RESEARCHSHIP	NO
4	DECKSHIPCARGO	CARGO - FV	17	ROROCARGOSHIP	CARGO-FV
5	FERRY	NO	18	ROROCARGOCONTSHIP	CARGO-FV
6	FERRYNONLOCAL	NO	19	SUPPLYOFFSHORE	NO
7	FISHINGFACTORY	NO	20	TUGTOWBARGE	NO
8	FISHINGVESSEL	NO	21	UNKNOWN	NO
9	LIQGASCARRIER	TANK - FV	22	USCOASTGUARD	NO
10	NAVYVESSEL	NO	23	VEHICLECARRIER	CARGO-FV
11	OILTANKER	TANK - FV	24	YACHT	NO
12	OTHERSPECIALCARGO	CARGO - FV	25	ATB	TANK - FV
13	OTHERSPECIFICSERV	NO	26	OIL BARGE	TANK - FV

Figure 42. Focus Vessel Classification of VTRA 2010 vessel types.

Figure 43 and Figure 44 displays 2D and 3D geographic profiles of non-focus vessel traffic, which predominantly consists of fishing vessels (41.3%), Tug-barge traffic[10] (22.9%) and ferry traffic (18.1%). The remaining 17.7% comprises of yachts, navy vessels, passenger ships and service vessels. In the sections to come, we shall provide separate geographic profile analyses for the focus-vessel class (24.8% of total traffic) of which its traffic density is depicted in 2D and 3D geographic profiles in Figure 45 and Figure 46, respectively.

[9] Of course focus vessels can also potentially collide with other focus vessels.
[10] This 17.2% does not include oil barge traffic which is considered a focus vessel class

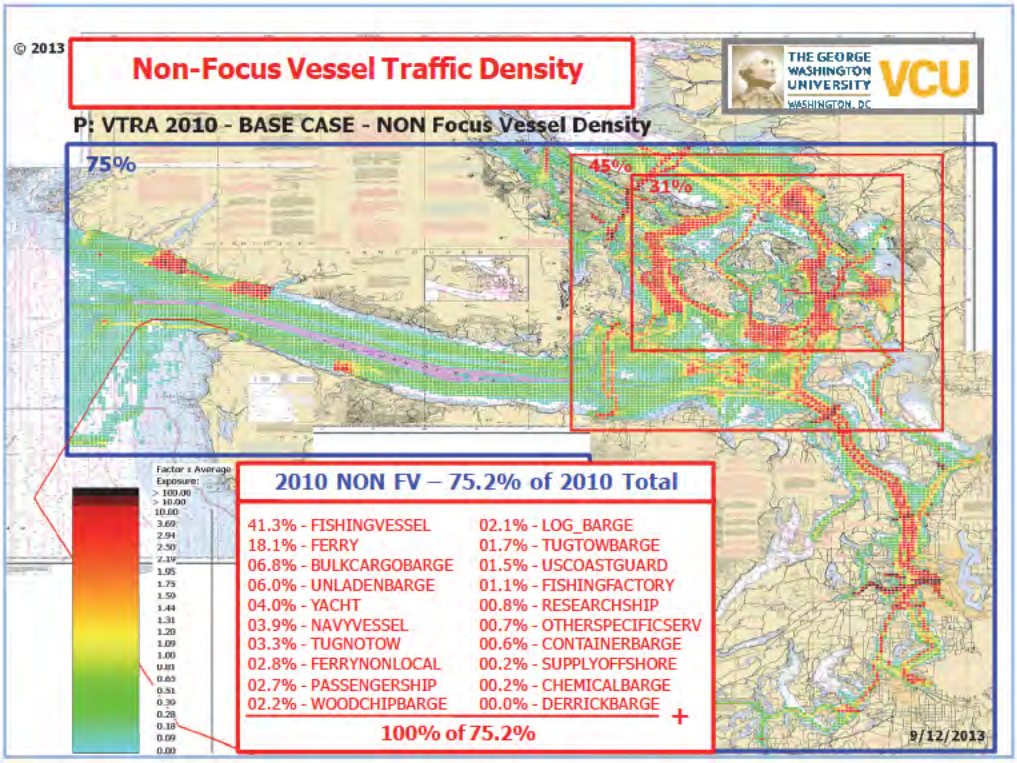

Figure 43. 2D depiction of the traffic density for all non-focus vessels.

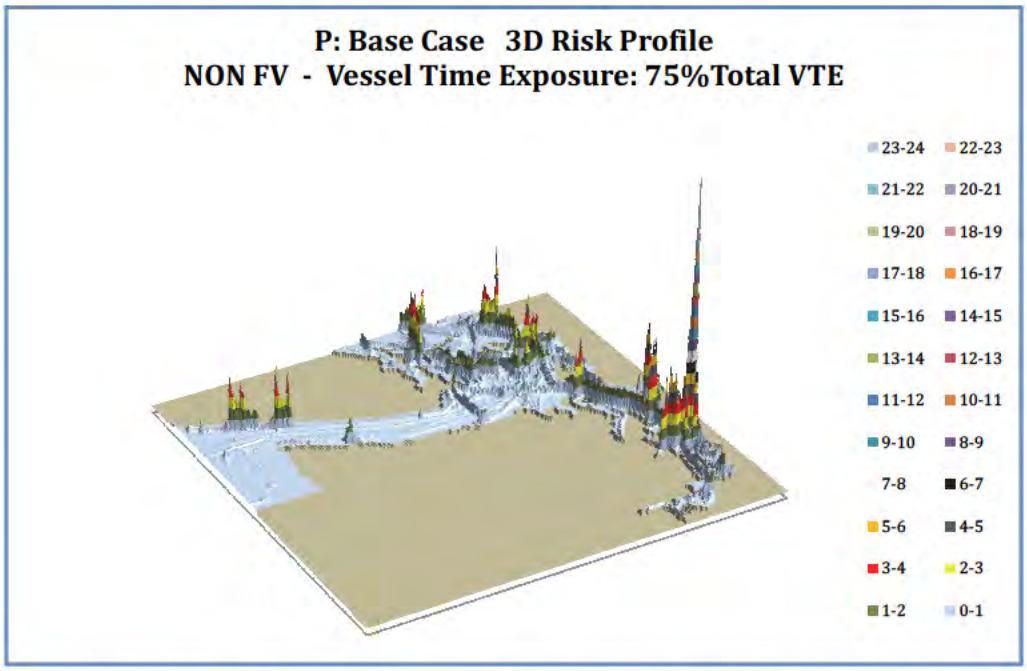

Figure 44. 3D depiction of the traffic density for all non-focus vessels.

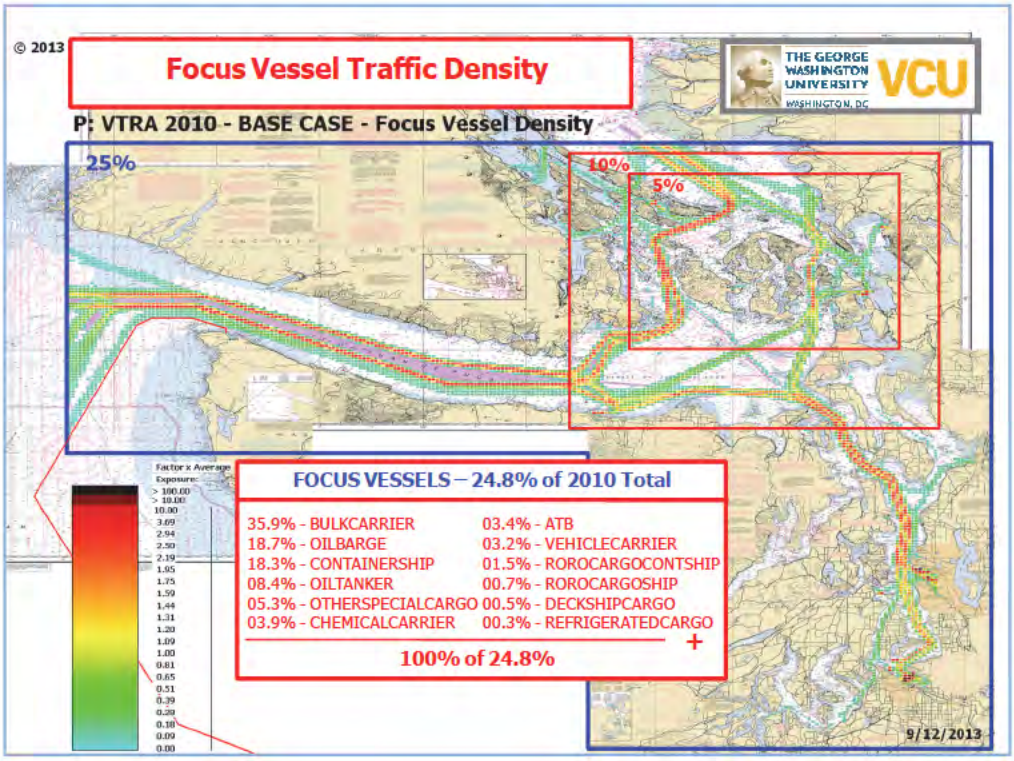

Figure 45. 2D depiction of the traffic density for all focus vessels.

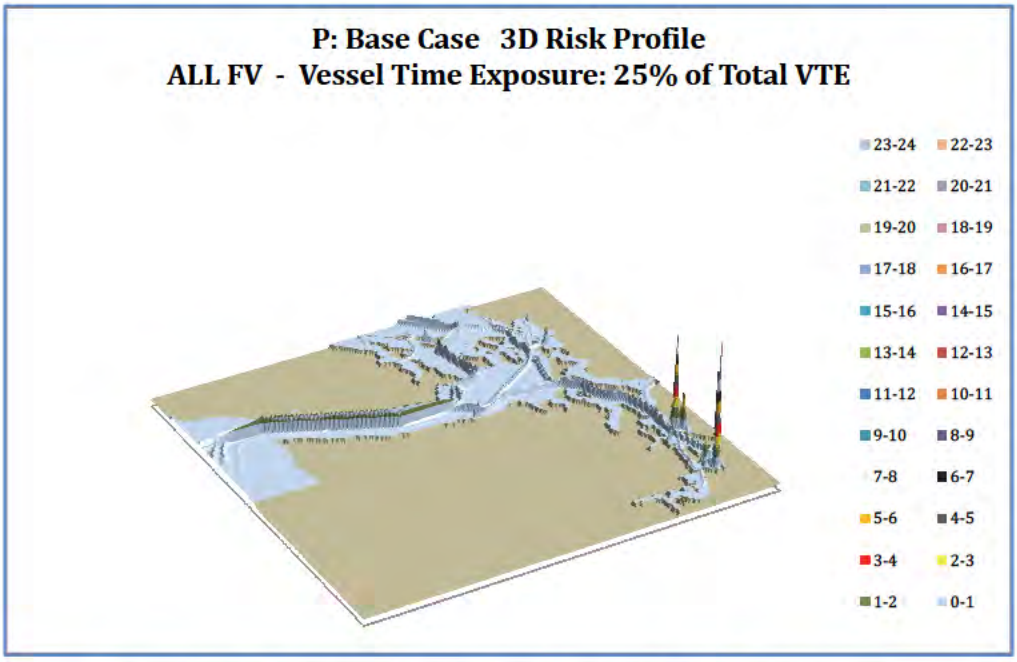

Figure 46. 3D depiction of the traffic density for all focus vessels.

In sections to come, traffic movements representing time of focus vessels on the water are summarized in terms of cargo focus vessel (bulk carrier, container and other cargo) density profiles and tank focus vessel (oil barge, oil tanker, chemical carrier and atb) density profiles. The oil (crude, product and fuel) that cargo and tank focus vessels transport are summarized in oil movement density geographic profiles. For contrast purposes focus-vessel density profiles shall be presented using their own color legend rather than the color legend used in Figure 43 and Figure 45.

Vessel Time of Exposure (VTE)

Let us first examine the time each type of focus vessel spends in the system; 65.7% of the focus vessel total time of exposure is attributed to cargo focus vessels, with the remaining 34.3% being tank focus vessels. Of the cargo focus vessel's total time of exposure, 54.6% is bulk cargo, 27.8% is container vessels, and 17.6% is other cargo vessels. Of the tank focus vessel's total time of exposure, 54.5% is oil barges, 24.4% tankers, 11.1% chemical carriers, and 9.8% articulated tug barges. To find the contribution of oil barges, for example, to the focus vessel total time of exposure, we consider that 34.3% of the focus vessel total is tank focus vessels and 54.5% of the tank focus vessel total time of exposure is oil barges, so 34.3% multiplied by 54.5% gives 18.7% of the focus vessel total time of exposure. Figure 47 shows the contribution of each focus vessel type to the total focus vessel time of exposure calculated in this manner.

Oil Time of Exposure (OTE)

Thus far, we have examined the focus vessel time of exposure, where we count the amount of time that vessels move through study area by grid cell. Rather than focusing on vessels it is also instructive to examine the amount of time a unit of oil (measured in either barrels or cubic meters) is moving through the study area. This includes cargo (product and crude) oil and fuel oil that focus vessels transport; so all focus vessels contribute to the total oil time of exposure; 39.4% of the total oil time of exposure is product, 36.9% is crude, and 23.7% is fuel. Figure 48 shows the total oil time of exposure broken down by vessel type. Tankers comprise almost half of the total oil time exposure at 48.1%. Oil barges comprise about a fifth at 20.6%. However, the vessel type with the next largest contribution is container vessels, which carry only fuel oil, at 8.9% and not chemical carriers. This is of course a result of the fact that more container vessels travel through the VTRA study area than chemical carriers. In fact, overall fuel oil from cargo focus vessels comprises 19.7% of the total oil time exposure.

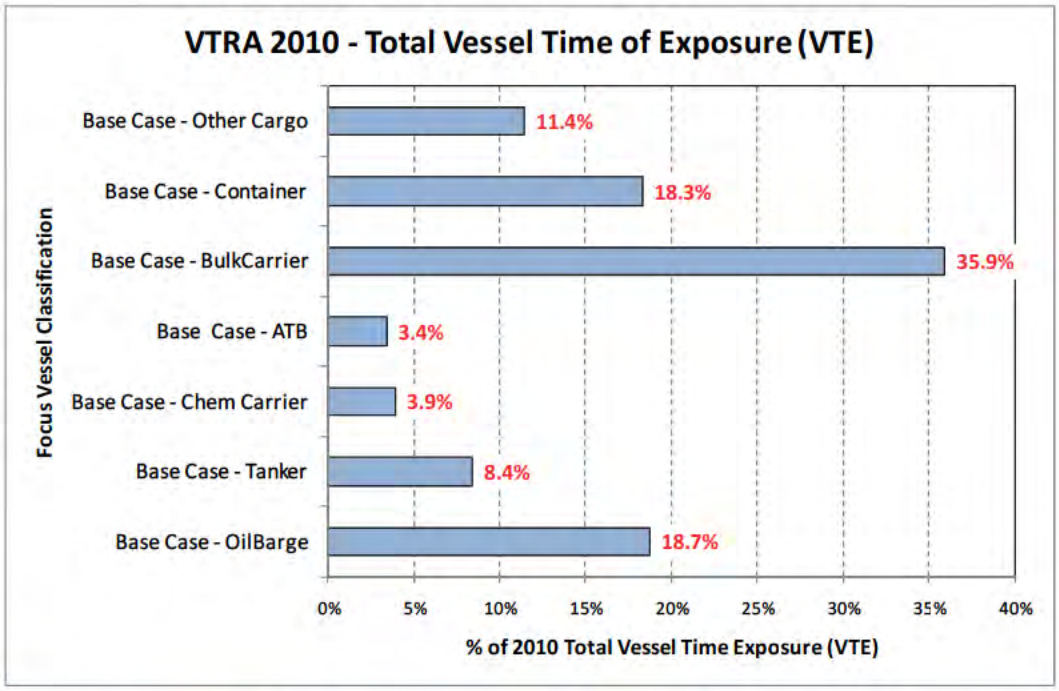

Figure 47.Comparison of the total vessel time of exposure by focus vessel classification

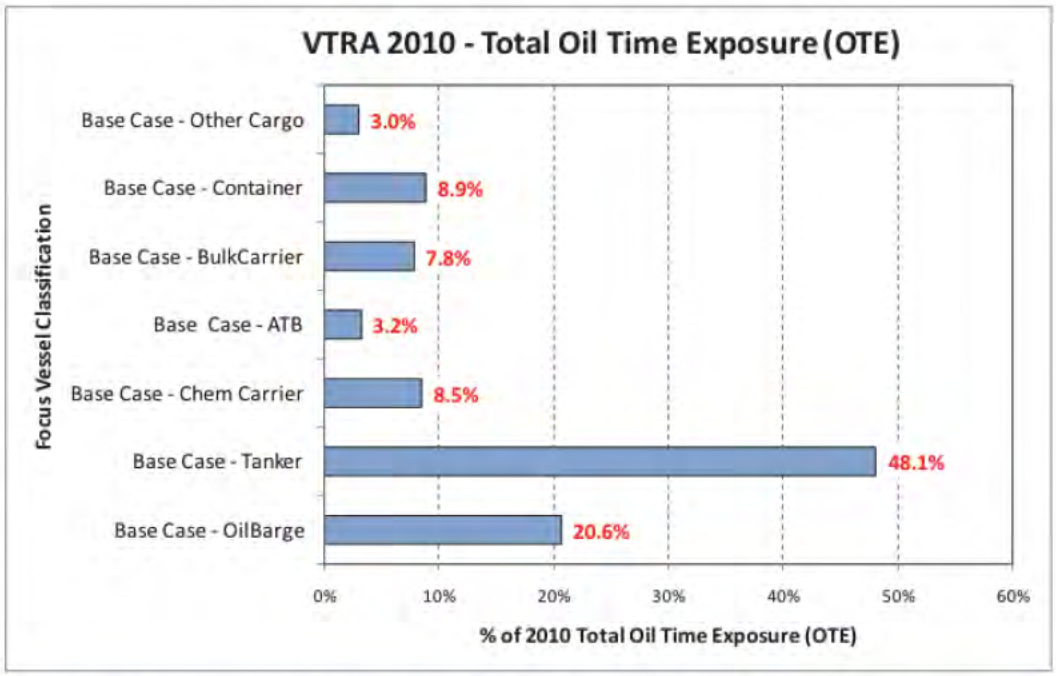

Figure 48. Comparison of the total oil time of exposure by focus vessel classification

Traffic Densities Profiles

Figure 47 shows that bulk carriers spend the most time transiting the study area at 32.5% of the total, followed by container vessels at 20.2%, and oil barges at 19.3%. Oil tankers comprise 8.8% of the total. While these aggregate statistics are useful, we are also interested in where these vessels spend time in the VTRA study area. Figure 49 and Figure 50 show the cargo focus vessel and tank focus vessel traffic densities respectively. The left panels of Figure 49 and Figure 50 show the 2D geographic profile format, whereas the right panels depict a 3D geographic profile. The 2D and 3D graphical profiles complement one another. While a 2D geographic profile provides more detailed information, the relative distribution of traffic density is more easily discerned from the 3D geographic profile format.

Comparing Figure 49 and Figure 50 is quite instructive. Apparently, cargo focus vessels transit the Straits of Juan de Fuca and then Haro Strait, Boundary Pass, and Georgia Strait going north and the Puget Sound going south. Meanwhile, the traffic density for tank focus vessels is most significant in Rosario Strait and Puget Sound (and near the pilot station in Port Angeles). Thus, cargo and tank focus vessels mostly transit different areas of the system, except for the Puget Sound where they converge.

Oil Movement Density

Again it is instructive to view the geographic spread of the oil movement exposure, called the oil movement density. Figure 52, Figure 53, Figure 54 shows the oil movement densities for product, crude, and fuel oil respectively. The left panels show the 2D geographic profile format, whereas the right panel depict the 3D geographic profiles. Product oil (39% of oil movement) moves throughout the system as depicted in Figure 52[11]. Figure 53 shows that crude oil (37% of oil movement) moves predominantly from Buoy J to the Cherry Point, Ferndale, and Anacortes refineries with the largest spike observed at the Cherry Point refinery in the right panel of Figure 53. Figure 54 shows that fuel oil (24% of oil movement) moves predominantly in the areas where cargo focus vessels transit in Figure 49. Figure 51 combines the information depicted in Figure 52, Figure 53 and Figure 54 and shows the total oil movement density. Thus, Figure 51 shows that oil moves on all major traffic lanes in the study area. The highest oil movement density areas are on the approaches to refineries and near the pilot station. We now know that the largest spike in the right panel of Figure 51 at the Anacortes refineries results both from product and crude oil, whereas the other two spikes at the Ferndale and Cherry Point refineries predominately arise from crude oil.

[11] The spike in Figure 52 is located at the Anacortes refineries.

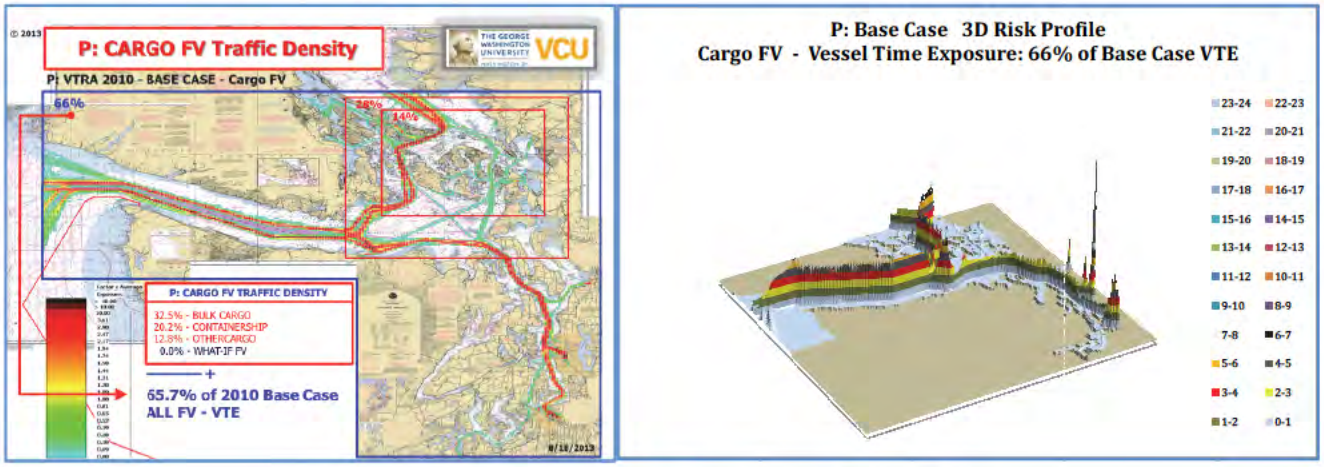

Figure 49. The traffic density for cargo focus vessels.

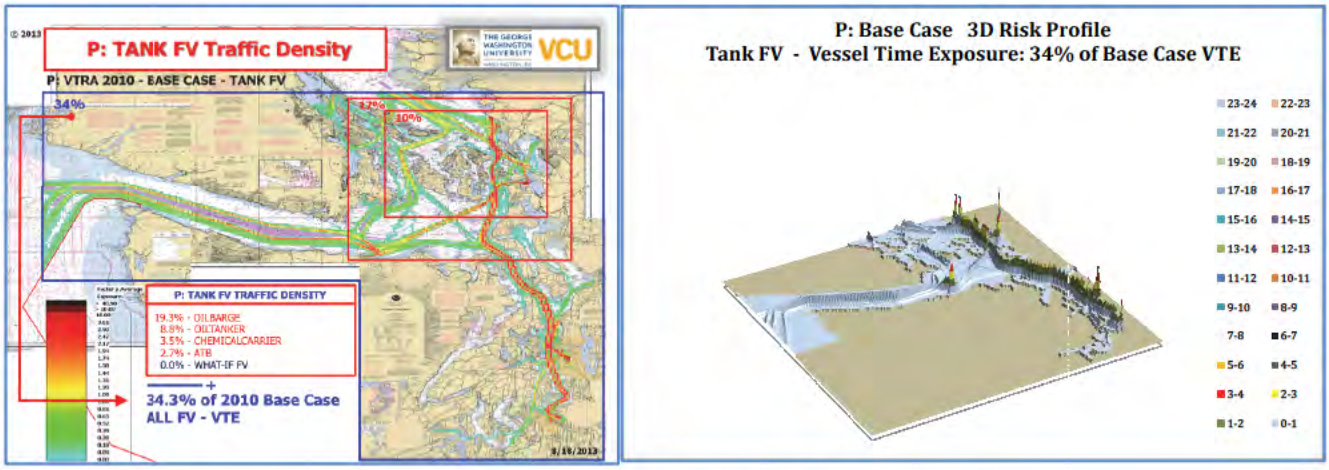

Figure 50. The traffic density for tank focus vessels.

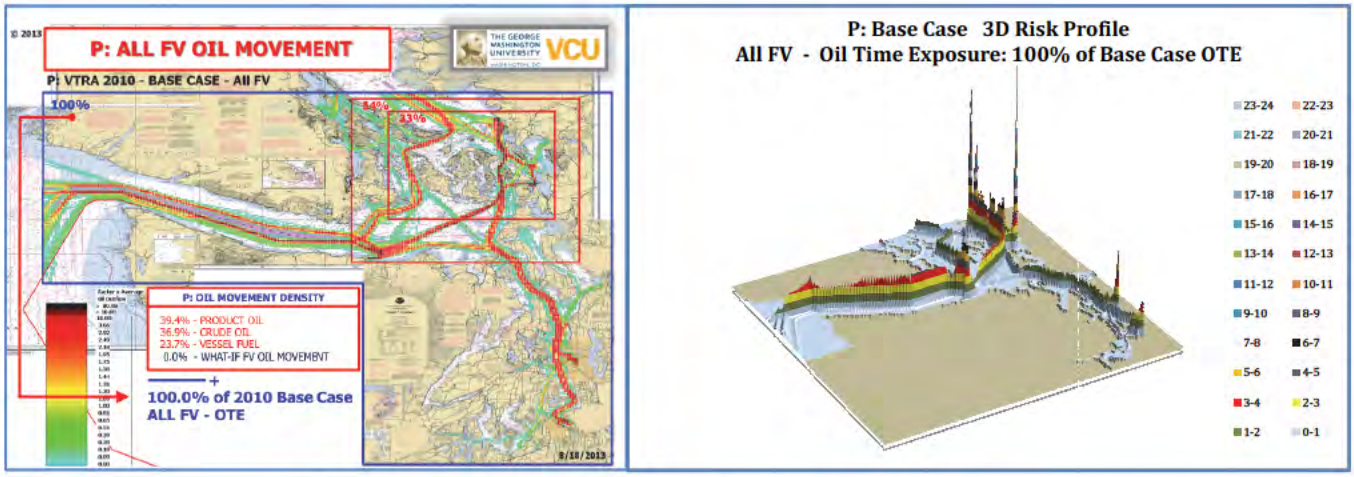

Figure 51. The total oil movement density for all focus vessel

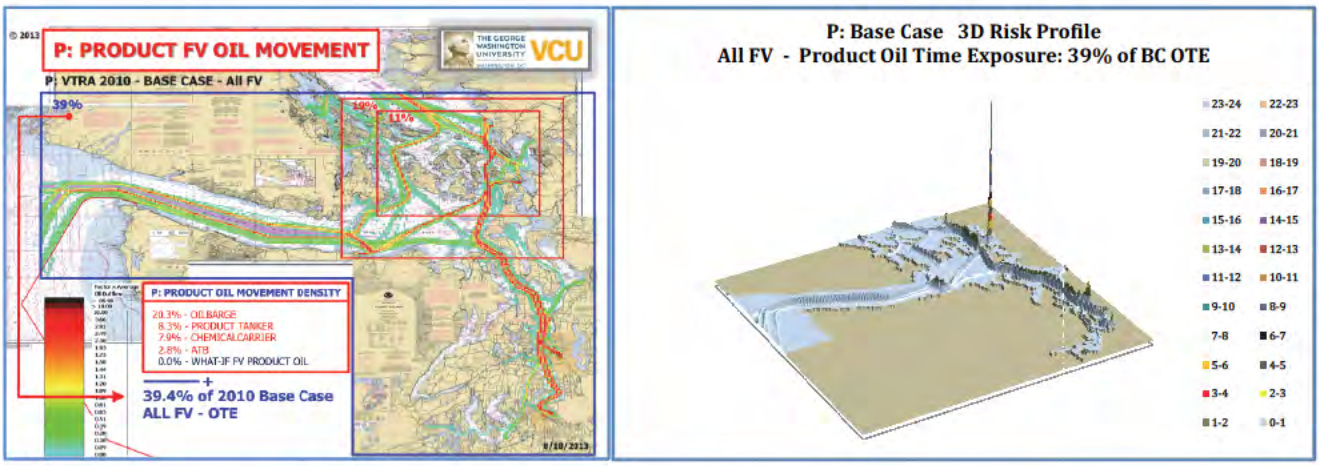

Figure 52.The product oil movement density for all focus vessels.

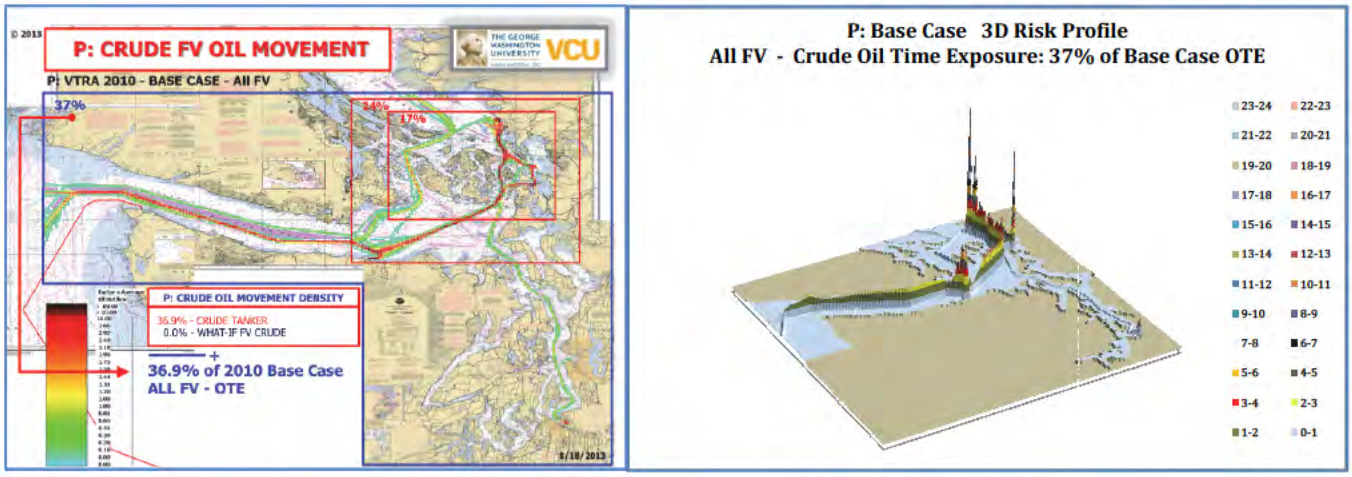

Figure 53.The crude oil movement density for all focus vessels.

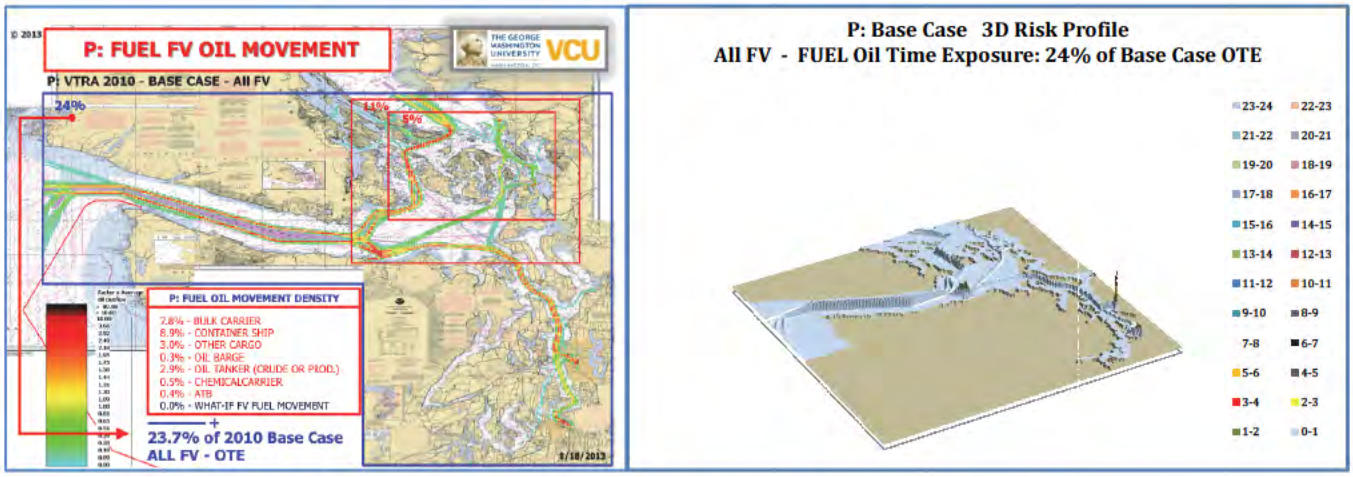

Figure 54.The fuel oil movement density for all focus vessels.