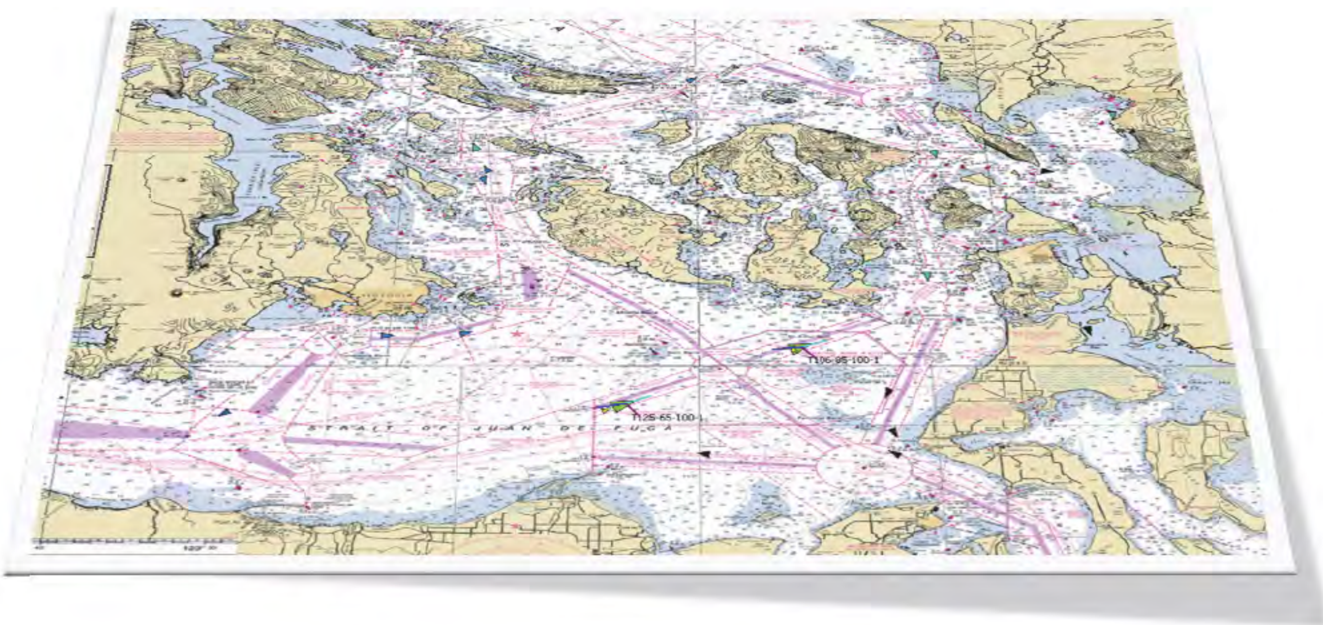
CHAPTER 1

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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1. INTRODUCTION

Washington State shares the Salish Sea with the province of British Columbia. A large number of ships and barges operate in these shared waters, placing the area at risk for major oil spills. While a recent study [2] demonstrated significant risk reduction of oil transportation risk due to existing risk mitigation measures[4], the potential for large spills continues to be a prominent concern for the region's environment, economy and quality of life, and the impact of a major spill would likely be devastating on the long-term restoration and protection of Puget Sound and Salish Sea waters. Public concern for protecting the environment while pursuing maritime economic developments was the catalyst for this study funded by the EPA through the State of Washington and the Makah Tribe. The VTRA study area includes: (1) portions of the Washington outer coast, (2) the Strait of Juan de Fuca and (3) the approaches to and passages through the San Juan Islands, Puget Sound and Haro-Strait/Boundary Pass.

The VTRA analysis is predominantly based on Vessel Traffic Operational Support System (VTOSS) 2010 data and will therefore be referred to as VTRA 2010 hereafter. Vessel traffic collision and grounding risks are evaluated for tank focus vessels (oil tankers, chemical carriers, oil barges and articulated tug barges) and cargo focus vessels (bulk carriers, container ships and other cargo vessels). The VTRA 2010 analysis shall serve as a base case year to compare potential changes in risk as a result of potential maritime terminal developments against. The purpose of this study is to inform the State of Washington, the United States Coast Guard and the Puget Sound Harbor Safety Committee on what actions could be taken to mitigate increases in oil spill risk from large commercial vessel oil spills in the northern Puget Sound and the Strait of Juan de Fuca as a result. It is also intended to inform tribes, local governments, industry and non-profit groups in Washington State and British Columbia on potential risk management options and to facilitate their input towards achieving consensus risk management decisions regarding vessel operations in the study area.

For context it is important to recognize that the base case 2010 VTRA analysis includes a series of risk mitigation measures. In addition to the previously mentioned IMO Traffic Separation Scheme and CVTS, vessels are subject to Port State Control and other vessel inspections regimes in both Canada and the United States to enforce international and federal standards. Pilotage is required in both the U.S. and Canada and pilotage areas are comparable. Tug escorts for laden tankers are required and tugs are used to assist vessels into and out of the berths. Moreover, there are a number of risk mitigation measures that have been put in place internationally, federally and locally over the last several decades including double hulls for tankers, protectively located fuel tanks for non-tank vessels (still being phased in), a Puget Sound Harbor Safety Plan with

[4] In [2] a 91.6% reduction in POTENTIAL oil loss was evaluated from all Tankers, Articulated Tug Barges (ATB's) and Integrated Tug Barges (ITB's) utilizing the VTRA 2005 model as a result of the implementation of the one-way zone regime in Rosario Strait, double hull tankers and the 2005 escorting regime.

Standards of Care, the implementation of AIS, a traffic procedure governing vessels transiting Turn Point at the boundary between Haro Strait and Boundary Pass northeast of Victoria, Canada and a one-way zone regime in Rosario Strait. This list is not exhaustive. This study was not designed to measure the effectiveness of risk mitigation measures already in place.

The VTRA 2010 utilizes the extensive technical work already completed by the George Washington (GW) University and Virginia Commonwealth University (VCU) under prior projects. Specifically, the Prince William Sound Risk Assessment (1996), The Washington State Ferry Risk Assessment (1998), The San Francisco Bay Exposure Assessment (2004) and the 2005 Vessel Traffic Risk Assessment (VTRA)[5]. Our method has been developed over the course of over ten years of work in maritime risk assessment, has been peer reviewed by the National Research Council and top experts in the field of expert elicitation design and analysis, and has been improved thanks to a grant from the National Science Foundation and interactions with stakeholders over the course of the above maritime risk assessment projects. A reference list is provided at the end of this document.

Our analysis model represents the chain of events that could potentially lead to an oil spill. Figure 3 shows the accident causal chain. We call a situation in which an accident could occur an accident exposure. Maritime Transportation Systems (MTS) have accident exposures from the movement of vessels within it. For each accident exposure, while the vessel is underway, incident and accident probability models are used to calculate the potential accident frequency. This is not a prediction of an accident, but shows a relative propensity that an accident could occur in one situation versus another or the relative propensity for one type of accident versus another. The accident exposure and the potential accident frequency are then combined with an oil outflow model to calculate potential oil loss. Throughout this report we shall use the terminology POTENTIAL to indicate that an accident exposure does not necessarily need to lead to an accident or oil loss, but may.

Our analysis model evaluates the duration that vessels travel through the VTRA study area (referred to as Vessel Time Exposure, abbreviated VTE), by vessel type. The inclusion of the time on the water element in the evaluation of exposure sets the VTRA 2010 methodology apart from count based approaches that focus on, for example, number of annual/monthly vessel transits, visits or calls. The value of a duration-based approach versus a count-based approach is that the VTE approach appropriately distinguishes between short and long transits in the evaluation of vessel traffic risk as well as high and low vessel speeds.

All models are abstractions of reality however through a set of simplifying assumptions. For instance, we only included a limited set of factors in our expert judgment questionnaires,

[5] The VTRA 2005 was limited to vessel traffic risk evaluation associated with tankers, atb's and itb's docking at the Cherry Point terminal.

otherwise we would have had to ask hundreds of questions and the experts would have grown tired and not have given useful, consistent information after a while. This also limits the level of granularity to which we can break down the factors. For instance, we must group similar types of vessels to reduce the number of categories (and questions) and we cannot model locations down to the seconds of the longitude and latitude coordinates. Essentially, as within any analysis model, we must make assumptions. However, we made every attempt to test our assumptions with experts and stakeholders through a collaborative analysis process. The updating of the 2005 VTRA model to the VTRA 2010 one followed this collaborative analysis approach involving coordination with Puget Sound stakeholders through the VTRA 2010 Steering Committee:

"*In collaborative analysis, the groups involved in a policy debate work together to assemble and direct a joint research team, which then studies the technical aspects of the policy issue in question. Representative from all the participating groups are given the ability to monitor and adjust the research throughout its evolution. Collaborative analysis aims to overcome suspicions of distorted communication giving each group in the debate the means to assure that other groups are not manipulating the analysis. The ultimate goal is to generate a single body of knowledge that will be accepted by all the groups in the debate as a valid basis for policy negotiations and agreements. – George J. Busenberg, 1999.*"

In this study, the VTRA 2010 Steering Committee (see Figure 2) chose to model only the traffic level impacts of planned expansion and construction projects that were in advanced stages of a permitting process. Each planned project forms a What-If scenario and What-If vessels are added to a maritime simulation of the 2010 Base Case year. Four What-If scenarios were modeled in the study:

- The Gateway bulk carrier terminal
- The Trans-Mountain pipeline expansion
- The combination of proposed changes at Delta Port
- All three of above scenarios operating at the same time

The Steering Committee determined that the following numbers of What-If vessels would be added to the 2010 Base Case simulation in each scenario:

- The Gateway bulk carrier terminal
  - 487 bulk carriers (318 Panama class and 169 Cape Max class)
- The Trans-Mountain pipeline expansion
  - 348 crude oil tankers (each 100,000 DWT)
- The combination of proposed changes at Delta Port
  - 348 bulk carriers and 67 container vessels
- All three of above scenarios operating at the same time

Moreover, the VTRA 2010 Steering Committee recommended that bunkering operations supporting these potential expansion projects be represented as well.

A summary of the 2005 VTRA methodology is provided in Section 2 with references to peer-reviewed publications and technical report dispersed throughout this summary. Needless to say, to more closely approximate the present-day patterns in traffic for What-If scenario analysis representing potential traffic expansions, it would be desirable for the GW/VCU VTRA 2005 analysis model to be updated with the most recent VTOSS dataset. The 2010 year is the last full year of traffic data recorded for VTOSS. The items below summarize the improvements made to 2005 VTRA methodology while updating the GW/VCU VTRA analysis model using the VTOSS 2010 efforts over the course of both the Makah and PSP funded efforts:

1. The total focus vessel class in the VTRA 2010 accounts for approximately 25% of the total traffic picture, whereas the VTRA 2005 only accounted for 1% of the total traffic. The VTRA 2005 only considered BP Cherry point tankers, ATB's and ITB's within the focus vessel class[6]. As per the PSP SOW this focus vessel class was expanded to include all tankers, ATB's and ITB's, bulk carrier, container vessels and oil barges. Over the course of the VTRA 2010, also "Chemical Carriers" and "Other Cargo" were added to the VTRA 2010 focus vessel class. The chemical carrier class is about as large as the ATB one. The "Other Cargo" class is combined about as large as the container focus vessel class. The inclusion of both "Chemical Carrier" and "Other Cargo" to the focus vessel class provides for an even more comprehensive analysis.
2. Individual vessel routes segments are used in the VTRA 2010, rather than using representative routes that were used back in the VTRA 2005 to create a more accurate traffic picture.
3. VTOSS 2010 data, which serves as the basis for the VTRA 2010, was validated against Automatic Identification System (AIS) 2010 data. This was not possible for the VTRA 2005 since at that time no AIS data was available. To accommodate this validation we:
    a. Introduced the notion of a vessel master type (Cargo-Focus Vessel and Tank-Focus Vessel) necessitated by vessel type misclassifications observed both in the VTOSS 2005 and VTOSS 2010 datasets.
    b. Added crossing line counting to the VTRA model to duplicate exactly the AIS 2010 crossing line count procedure.
4. Calculated speeds are used in VTRA 2010 model as opposed to sampled speeds in the VTRA 2005 to more accurately reflect exposure times of focus vessel classes.
5. In terms of potential oil outflow analysis we are considering overall oil loss, cargo oil loss and fuel oil loss and we are providing separate analyses for each. This is a change from the former "persistent oil" and "non-persistent oil" classification used in the VTRA 2005 and mentioned in the PSP SOW. However, the oil loss, cargo oil loss and fuel oil loss classification is more meaningful given the focus vessel class expansion.
6. Analysis capability was created to not only include more vessel types to the focus vessel class, but also allow for separation of the analysis by each focus vessel type, as well as the Tank-FV and Cargo-FV master type. Allowing for separation of analysis by focus vessel type may prove useful during the risk management phases.

[6] During the 2005 VTRA, focus vessels were referred to as Vessels Of Interest (VOI's)

7. The notion of What-If focus vessels was introduced to model the added traffic to the 2010 base year to represent the potential addition of Gateway, the Trans Mountain and Delta-Port expansions. This allows for a separation of added system risk into What-If focus vessel risk and risk added to the Base Case focus vessel class (as a result of adding What-If focus vessels).
8. A bunkering model was added to the VTRA 2010 model. Inclusion of a bunkering model to support these What-If focus vessels is an important part of the What-If analysis. The bunkering model addition to the VTRA model for What-If scenarios was not foreseen during the initial SOW negotiations and was not included in 2005 VTRA. Analysis capability was created to allow for separation of What-If risk into "bunkering risk" and "Other What-If FV" risk.
9. The comprehensiveness of the analysis makes synthesis into an overall system view that highlights important aspects of analysis results more challenging. A great deal of time was spent to develop an analysis presentation format to arrive more easily at such a systems view of risk. Most importantly, these synthesized presentation and analysis results will allow stakeholders (hopefully) to still see "the forest through the trees". It is important for stakeholders to have this overall systems view prior to devising risk management suggestions.
10. Progress presentations and detailed scenario result presentations are available in electronic portable document format (pdf) from a VTRA 2010 project web-page:

http://www.seas.gwu.edu/~dorpjr/tab4/publications_VTRA_Update.html

In Section 3, we describe the updating of the 2005 VTRA model to the 2010 VTRA in more detail. In Section 4, the validation of GW/VCU model crossing line counts using AIS 2010 crossing line counts is described. Section 5 describes VTRA 2010 focus vessel traffic movement and the movement of oil volume that these focus vessels carry. The information described in Section 5 serves as the starting point for the base case VTRA 2010 potential accident frequency and oil outflow analysis described in Section 6. The modeling of What-If scenario's and the changes in POTENTIAL accident frequency and POTENTIAL oil outflow from the VTRA 2010 Base Case is presented in Section 7. In Section 8, similar analysis results are presented for a variety of RMM scenarios, whereas Section 9 describes the construction of bench mark/sensitivity analysis scenarios to compare the What-If and RMM scenarios against. We close the report with conclusions and recommendations in Section 10.