

**Introductory Model Development Webinar: Salish Sea Focus**  
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Patrick Wicklund, *Washington Military Department*  
John Wright, *Polar Tankers*

The following summary notes are not intended to be a transcript but rather a review of the question and answer session that took place at the conclusion of the webinar. Attendee questions and comments are shown in bold text followed by Ecology responses. The questions that we didn't have time for in the webinar are at the bottom of the document, with written responses provided.

**How will the model incorporate tidal issues and weather? (Kip Killebrew)**

JD Leahy: We are still in the model development phase and at this early stage we don't want get into modeling specifics. We are still focused on building the basic framework of the model.

Alex Suchar: We are definitely thinking of including this information, but exactly how we include it will become more clear later in the process.

**Lots of traffic is supporting trade in Canada, how do you plan to approach the bi-national aspect of this? (Robert Lewis-Manning)**

JD Leahy: We are approaching this through open invitations to our events to Canadian partners and First Nations. We also hope to work with experts on Canadian side like BC Pilots and others. We are focused on building the best model, which will require that we include Canadian parts of the waterway. We look forward to open dialogue and communication with folks on the other side of the border.

Brian Kirk: The model is agnostic about where the international boundaries are and which port the vessels are heading to. We appreciate and welcome Canadian participation, and the model will be a lot stronger with Canadian experts and data. In addition, the first two analysis efforts will also include consideration of Canadian input.

**Will the modeling include close call events over the last 5 or 10 years? (Paul McCollum)**

JD Leahy: Great question, this is also referred to as near miss information. Near miss data can be hard to come by and challenging to use. However, there are some sources of near miss data that we have looked at and we are interesting in incorporating this type of information into the model.

**Will the previous risk assessments be included in the model and if so how? (Amber Carter)**

JD Leahy: We will be building off the foundations of previous risk assessment work; this doesn't mean that we will be starting with this work or using anyone else's model.

Brian Kirk: We will refer to previous assessments. We are not designing this model to be compatible with previous models, we want to build the best model that we can. Previous studies will be useful with model validation. We will compare results with previous efforts.

**Curious as to what you are using to inform the model, and what data you will include? Are there similar projects you are drawing inspiration from? How this will the model be built and what's going into it? (Salma Abdel-Raheem)**

JD Leahy: At this point, we are starting with AIS data and vessel incident and casualty data.

Alex Suchar: Yes, we are drawing inspiration from a lot of previous work. I have been working on pulling the literature together and coming up with all the possible methods available. We'll discuss strengths and weaknesses of these approaches and find the method that will be able to respond the best to our research questions. There is lots of work in Europe, Canada and the US that we are looking at.

**Can you clarify how Canadian data will be included? Will you have access to Canadian port data like on the US side? (Jamie Stephens)**

JD Leahy: It's not that Canadian waterways or vessels would be outside of the scope of modeling. Rather, recommendations on policy initiatives, and how they relate to transboundary waters will be decided at Ecology leadership level. We will definitely be looking at Canadian waters and traffic. In terms of access to Canadian data, the Canadian government provides a casualty database as well that we've been looking at. We'll be getting AIS info from Canadian bound vessels as well.

**A question I would like the model to answer is the degree to which vessel time exposure is a proxy to oil spill risk. (Rachael Mueller)**

JD Leahy: Great comment, thank you.

**Will Ecology take into account the USCG record of spills of oil barges and the quantity of spills? (Russell Shrewsbury)**

JD Leahy: That's the type of information we will be looking for.

Alex Suchar: Within incident data, there is data that summarizes incidents, and also actual incident reports. We are investigating to what extent we can use that information, and this is definitely something we are interested in. We will provide more detailed information on this topic later in the model development process.

**I think the model should also include transits time of a rescue tug's proposed mooring to various areas within Rosario Strait. It can take a fair amount of time to get from one place to another based on what the current is doing. (Russell Shrewsbury)**

JD Leahy: Thanks for this comment. Getting comments like this highlights the value of having experienced folks in the room.

**What are things that need to be taken into account with Articulated Tug and Barge due to their size? (Lena Collins)**

JD Leahy: As we look into model development, we'll be looking at unique aspects of each vessel that we are modeling. ATBs do have unique characteristics that we'll want to think about.

**Thank you. That is one of the areas that we are working on right now as part of one of our pilot projects. Having a better understanding of the abilities of these vessels is really going to help our process. (Lena Collins)**

JD Leahy: Any information that you can share on the work you are doing will be very helpful and welcome.

**Why have you limited the modeling to vessels 300 tons and larger? (Kip Killebrew)**

JD Leahy: The language of bill says that we must evaluate oil spill risks from covered vessels, which include those cargo, passenger and fishing vessels 300 gross tons or larger, and tank vessels. This doesn't mean the model can't incorporate the movements and effects of other vessels. We imagine we will include those other vessels. However, specifically when quantifying the risk of oil spills, we'll just be looking at the risk from those covered vessels since that's what is in the bill. The reason for that is that that is what is in the legislated language.

**For both questions 1 and 2, I'm interested in spill risk in Salish Sea, inclusive of Canada waters. From your presentation, I understand that Canadian waters are not included in this study but as whales and oil fate are transboundary, it seems as though the risk analysis ought to be as well. (Rachael Mueller)**

JD Leahy: We are balancing the legislative direction that we must model risk in Washington waters, with the reality that the Salish Sea is a transboundary waterway. In order to be successful, the model needs to incorporate all relevant waters – which will mean that we will need to include some Canadian waters.

**One of the great challenges that we have had in the past is the lack of oil spills. We don't have a lot of incidents to calibrate on. Spills are rare, and there is also the degree to which we have confidence on the reporting of incidents that aren't quite spills, particularly from Canada, that seems to have underestimated the risk exposure that we face. Just recently, I noticed that a ship in the Strait of Juan de Fuca had lost propulsion, but didn't hear anything about it. When calibrating for oil spill probability when you have 3 spills at best, how do you deal with the statistical challenge? (Fred Felleman)**

JD Leahy: There are a couple ways to approach this challenge, for instance, look at the low number of spills and come up with a couple of different possible spill rates, and use these multiple rates to calibrate the model and produce an uncertainty range. Another way to approach this would be to look at larger datasets, that include other waterways, but figure out a way to keep those spill rates calibrated to the Salish Sea. Right now, we are thinking of different ways to approach this. We haven't decided how we will handle it, but we certainly recognize this will be a challenging component of the modeling effort.

Alex Suchar: This is a very good question. This is why maritime risk assessment is not easy to do. Every model is as good as the data that is available. It remains to be seen how we can best calibrate an incident rate, with so few incident reports. One thing that we do know, is it will be essential to quantify the uncertainty related to the model outputs. This will be one way to show the limits of the model. Traditionally, one way to calibrate a model is to see if the model can predict an outcome that wasn't included in the initial data that was used to build the model. Since we are looking at oil spills, which are relatively rare, one way to calibrate the model will be through simulation, to see where the observed data fits within the distribution of potential model outcomes.

**Having watched the waterway for many years, I have noticed that sometimes vessel [arrivals] cluster up, and sometimes they spread out. In previous modeling efforts we've looked at randomized vs. one a day entries, and I think that when we modeled one vessel per day we found more risk. I've noticed that towards the weekend it's busier, and I've gotten some confirmation from pilots on this. There can be long periods of time of empty water, but on a Saturday it can be very busy. How can you deal with this distribution problem? (Fred Felleman)**

Alex Suchar : This is part of the strength of using the AIS data. We actually can know when vessels have been in the waterway. We can build a distribution based on when the vessels are usually coming, by looking at AIS data for several years. We can then use this information to figure out if vessels are coming more frequently at certain times of the year, certain times of the day, or certain times of the week. You make a good point that getting the right distribution of vessel density is crucial to the modeling effort.

**Twenty years ago they used incident data from Mississippi to apply to the Strait of Juan de Fuca, and that relates to Fred's question. I didn't agree with it then, and it predicted 3 major spills in the Strait of Juan de Fuca. This was wrong since they used data from Mississippi which is not the Strait of Juan de Fuca. If you are looking at actual collisions and groundings in other waterways,**

**it's problematic. Another study I saw included engineering analysis of hull penetration, which gets into oil outflow or not. Are you going to incorporate engineering analysis with respect to force needed to cause oil outflow? And what about differential consequences from different types of oil? Less vs. more persistent oil and proximity to sensitive areas? The last question is tug density, besides the ERTV, and natural distribution of all the other tugs and what might change with changes in tug density with regards to what Canada is doing. (Mike Moore)**

JD Leahy: Thanks for comments. Like I said in the presentation, there are a lot of people on this call, and people not on this call, that have participation in a lot of this work over the years. That experience and knowledge is going to be really valuable and helpful as we get into model development. In terms of oil outflow -- all of the aspects that you mentioned, like fuel tank location, bottom characteristics for groundings, energy generated -- those are all important aspects to determining oil outflow. Those are certainly all things that we are going to be talking about and discussing as we get to that part of model development. In terms of the question of spill consequence, we are going to have to discuss how to characterize spill risk, but we are not currently looking at characterizing sensitive areas or non-sensitive areas. We are looking at spill volume and spill frequency as primary motivators of our risk characterization. As to the changing character of tug density, we absolutely want to include this. We are seeing different rules come into play these days [e.g. tug escort requirements per ESHB 1578] and want to represent tug density accurately. Tugs are unique in that sometimes they aren't busy, and they can help out other vessels, which will be an important thing to include in the model.

Brian Kirk: Regarding characteristics of types of oil – when we get to the point where we are discussing the outputs of the model and what that looks like, we will absolutely need to talk about those characteristics. There are clear differences in the impacts of the spill if we are talking about diluted bitumen versus gasoline, for instance. We are thinking about how we can capture this type of information. We'll have to draw the line somewhere that bounds the information that is an output of the model. We will need to be thoughtful about where that line is, so the model inform the policy considerations that people may have while considering modeling results.

**Will you be using a basic risk model structure (probability vs. severity) or creating a brand new one? (Paul Devries)**

JD Leahy: We'll be using existing language and characterization of risk, similar to the example given – probability x consequence. But we will be building our own version of that and breaking down the modeling effort into series of modules. We will work through these together during our public events and as part of our discussions. The basic components of the model are not things that we have made up – lots of people have worked on them, and studied them. We are going to put them together in an open forum, and open discussion, and what we end up making will be a new model. It won't be a model that anyone else already has in play.

Alex Suchar: We are looking at a building quantitative model, so we won't be classifying the incidents on a scale from low to high severity.

**Is this a drift model? Does it focus on surface transport only? (Heather Parker)**

JD Leahy: The model will need to characterize drifting of vessels that have lost propulsion or have steering issues. Yes, we will only be looking at surface transportation.

**Can we see a map of the model area? (Heather Parker)**

JD Leahy: We don't have a map currently but we'll be talking about the modeling area as we move into the presentation on our approach to modeling.

**What is the problem the legislature identified that these model development and analysis efforts are designed to solve? (Scott Clemans)**

Brian Kirk: The legislature has a long-standing interest in oil spill prevention, and they have given Ecology a series of goals to aim for and assignments to complete in addition to our day-to-day work of spill prevention, preparedness, and response. Broadly speaking, the Governor's Office and the Office of Financial Management were interested in developing public capacity for oil spill risk modeling and analysis. We have to be able to provide answers to questions relating to tug escorts around certain tank vessels that aren't currently required to have tug escorts, and the question of whether an Emergency Response Towing Vessel (ERTV) could provide an oil spill risk reduction benefit for Haro Strait, Boundary Pass, and Rosario Strait. Beyond answering these questions, the legislature wanted a tool to answer future oil spill risk questions.

**Can the model evaluate non-oil spill components of oil spill prevention measures? For example, can it predict changes of underwater noise levels in waters frequented by Southern Resident Killer Whales? Second can it weight the variation in sensitivity of nearby species and habitats? A spill near a major rookery may be more deleterious than a spill not impacting those resources. (Don Noviello)**

JD Leahy: Underwater noise is not currently within the scope of the model. The model is focused on oil spill risks, so noise is not something that we are currently looking at. The movement of oil once it has been spilled is not part of our current set of plans for the model. But this is something that we can look at this further down the road.

Brian Kirk: Fate and effect, and the sensitivity of certain habitats and species are tightly linked to oil spill risk and the consequences of spill risk. We will have to make decisions about what we include in the initial phases of model development and what goes into the initial analyses. Our thinking so far has been that a lot of the detailed work around fate and effect is probably going to be outside of the initial scope of model development. That said, we appreciate people bringing this up throughout this process. This will help us get this right so that we can produce usable information. We are interested in finding solutions and good ways of presenting information so that it is most useful. A lot of people are doing work around habitat sensitivity and what would happen if there was a diluted bitumen spill around the San Juans, for example, so please continue to bring this to the conversation so we can provide the best information possible.

**What is the previous work that you hope to use to inform and build this model? Also, earlier I meant the propensity for oil spills to occur (biophysical environmental characteristics, etc). (Salma Abdel-Raheem)**

JD Leahy: Like Alex said, we are looking at a lot of research coming out of Europe. There is research in China and Baltic Sea as well. We can provide a more detailed answer in writing later.

Alex Suchar: There is a lot of work being done in Europe. In the Netherlands, they have a live model that they are using to assess risk. Norwegians and the Finnish have developed good models. There is a lot of theoretical development coming from Asia as well. Definitely we are investigating all these possibilities and are trying to pick the best methods, and design our own model using the best approaches that we have identified.

Supplementary answer:

There is a large volume of work regarding various aspects of the maritime risk. Our current model development library contains over 700 titles at this moment, without claiming to be complete.

Here are a few examples of the tools and risk assessments from across the world:

- The Helsinki Commission (HELCOM) developed OpenRisk Toolbox - a set of tools and techniques to be used for identifying hazards and analyzing risks of maritime activities: <https://www.aidic.it/cet/19/77/173.pdf>
- The International Association of Marine Aids to Navigation and Lighthouse Authorities IALA is actively using the IWRAP maritime risk assessment modeling tool. It can be used for free by IALA members. <https://www.iala-aism.org/technical/risk-analysis-and-management/risk-management-tools/quantitative-risk-management-tools-iwrap/>
- An example of work conducted in Asia: Marine Traffic Risk Assessment for Hong Kong Waters, MARA Study: <https://www.mardep.gov.hk/en/publication/pdf/marars.pdf>

Here are some projects that were done in Washington State

- Vessel Traffic Risk Assessment (VTRA): <https://fortress.wa.gov/ecy/publications/SummaryPages/1708009.html>
- Grays Harbor Vessel Traffic Risk Assessment: <https://fortress.wa.gov/ecy/publications/summarypages/1808017.html>
- BP Vessel Traffic Risk Assessment: <https://www.coaltrainfacts.org/bp-vessel-traffic-risk-assessment-assessment-of-oil-spill-risk-due-to-potential-increased-vessel-traffic-at-cherry-point-washington>

Here are some papers that we are looking at as part of our literature review:

- Qu, Xiaobo & Meng, Qiang. (2012). Development and applications of a simulation model for vessels in the Singapore Straits. *Expert Systems with Applications*. 39. 8430–8438. 10.1016/j.eswa.2012.01.176.
- Montewka, J. (2009). Predicting Risk of Collision for Oil Tankers in the Gulf of Finland, *Journal of KONBiN*, 11-12(1), 17-32. doi: <https://doi.org/10.2478/v10040-008-0128-1>
- Goerlandt, Floris & Montewka, Jakub & Kuzmin, Vladimir & Kujala, P.. (2015). A risk-informed ship collision alert system: Framework and application. *Safety Science*. 77. 182-204. 10.1016/j.ssci.2015.03.015.
- Wang, Ning & Meng, Xian Yao & Xu, Qingyang & Wang, Zuwen. (2009). A Unified Analytical Framework for Ship Domains. *Journal of Navigation*. 62. 643 - 655. 10.1017/S0373463309990178.
- Arsham Mazaheri, Jakub Montewka, Pentti Kujala. (2016). Towards an evidence-based probabilistic risk model for ship-grounding accidents. *Safety Science*. Volume 86. 195-210. <https://doi.org/10.1016/j.ssci.2016.03.002>.
- Ylitalo, J. (2010). Modelling marine accident frequency. Alto University School of Science and Technology Faculty of Information and Natural Science.

**Will the model take into account anticipated increases in vessel traffic due to proposed infrastructure projects in Canada and US? For example Transmountain and Roberts Bank T2 and any refinery expansions in the US? (Rein Attemann)**

Alex Suchar: It is not that the model will take into account these expansions. Better stated, the model will be capable of modeling these changes in traffic if needed. This is our objective, to build a model that is capable of modeling all of these changes in the conditions, and traffic levels.

**The following questions have been answered in writing, after the completion of the webinar. We did not have enough time to address them during the webinar.**

**Who monitors the moorage sites for oil tankers in the Salish Sea? What are we doing to ensure clean waters; monitoring which ships are docked where, who is dumping effluent and bilge water that contaminates oyster beds, kelp beds, monitor what ships are "burping" stinky gas that hangs around for days when pressure is released from the shipment of bitumen? (Laurie Sherman)**

The US Coast Guard and Canadian Coast Guard jointly monitor vessel traffic in the Salish Sea under their Cooperative Vessel Traffic Service (CVTS), including the movements of oil tankers. In the US, discharges from vessels are regulated by a number of state and federal agencies, including the US Coast Guard, the Environmental Protection Agency, Department of Ecology, and others. Air quality is regulated by the EPA and state agencies, including Ecology and local clean air agencies,

such as the Puget Sound Clean Air Agency, the Olympic Region Clean Air Agency, and the Northwest Clean Air Agency.

**Does your assessment include review of certifications and history of vessel captains' performance, as many accidents seem to be related to the captains management? (Laurie Sherman)**

Crewmember performance related information is generally inaccessible to researchers. It is unlikely that we would be able to include this type of information in our model.

**To follow up on Rachel's comment about time exposure - some people believe that the longer we go without an oil spill, the higher the risk is that we will experience a spill. But oil spill risk is not like earthquake risk. Each ship is an independent event. Will the model consider this when thinking about the impact of time exposure? (Meghan Mathieson)**

Yes. The phrase time exposure has historically been one way to look at the risk of an oil spill happening in a given area. There are different ways to calculate it, but one way would be to examine the amount of time a unit of oil spends in a particular area. Areas where more oil spends more time, could then be identified as areas at higher risk of an oil spill. The 2010 Vessel Traffic Risk Assessment (Prepared for Puget Sound Partnership in 2014 by George Washington University) included this type of analysis.

**Given that there are so few oil spill incidents to draw upon, will null data be included as part of the model? (Meghan Mathieson)**

Lack of local incident data has been a key point in previous maritime risk modeling work, and we want to have open and inclusive conversations about the different aspects of ways to tackle this issue. Regardless of how we choose to address this, this issue highlights how important it will be to quantify the uncertainty related to model outputs. Quantifying uncertainty will shed light on the limits of our model and clarify its areas of strength and its areas of weakness.

**Are you planning on providing public and freely accessible grids of spill risk probabilities by vessel types? (Rachael Mueller)**

Model details and model outputs will be public and freely accessible. We have not yet determined what types of products (e.g. maps) may best suit risk characterization.

**As the USCG, CCG, and TC play such a fundamental role in identifying, mitigating, and managing risk, how will [Ecology] liaise with these organizations and have formal commitments been made? (Robert Lewis-Manning)**

Throughout this process, we will maintain a transparent approach to model development, and we encourage and welcome the input and participation of the US Coast Guard, the Canadian Coast

Guard and Transport Canada. We have not made formal agreements with any of these organizations specifically connected to model development.

**I am wondering about the parameters to include/exclude different vessels from the model - "oil spills from covered vessels in Washington waters" - are all vessels that carry oil included, including those carrying oil as fuel? (Meghan Mathieson)**

When calculating risk of oil spills, we will use the definition of oil contained within RCW 90.56.010 (19). This definition includes maritime fuels like diesel, gasoline, and ship bunkers.

**Will the model include all types of oil products such as raw vs. refined and floating vs. sinking oils? (Kip Killebrew)**

When calculating risk of oil spills, we will use the definition of oil contained within RCW 90.56.010 (19). This definition includes both crude and refined product and oils that typically float on the surface of the water as well as oils that may sink or submerge.

**What software package does the agency intend to use for the model development? (Amber Carter)**

We are not purchasing a specific modeling software package as part of this effort. At the moment, we are using a number of different types of software for handling data and statistical processing.