7. The Game of Risk

From endangered killer whales and highly valued habitats, to a coastal economy and culture that depends on nature's services and benefits, there is much to cherish in the Salish Sea. Yet, increasing tanker traffic places this entire region at risk at a time when climate change and cumulative human impacts already stress coastal wildlife (DFO 2015, Gaydos et al. 2008). This chapter focuses on the risk that Kinder Morgan's proposal poses to our coastal wildlife and a way of life.

Understanding Risk

We subconsciously calculate risk every day. Deciding where to let our children play and when it is safe to cross the road are risk-based considerations. In environmental assessment, risk is the potential for loss resulting from an action, activity or inaction, whether predicted or not.

Quantified risks provide information to evaluate and manage potential hazards. They are the product of the probability of an event occurring multiplied by the expected harm, or consequence, caused by that event. Simply stated, Risk = Probability x Consequence. Accordingly, when the probability of an accident is low but the consequence high, the risk remains high.

Table 7.1 Risk is a combination of probability (likelihood) multiplied by consequence (impact).

Likelihood	IMPACT OR CONSEQUENCE				
	Insignificant	Minor	Moderate	Major	Severe
Almost Certain	Moderate	High	High	Extreme	Extreme
Likely	Moderate	Moderate	High	High	Extreme
Possible	Low	Moderate	Moderate	High	Extreme
Unlikely	Low	Moderate	Moderate	Moderate	High
Rare	Low	Low	Moderate	Moderate	High

Probability, Risk and Uncertainty

Gambling is a good example of risk taking. A dice toss has one of six possible outcomes. No one knows what number will surface, but we know what the distribution looks like. Putting your money on a number has a known consequence (good or bad) and you know the odds of that consequence occurring. There is always certainty, even though the process is random and the outcome is unknown.

Uncertainty is different. We don't know what is going to happen next, and we do not know what the possible distribution (the odds) looks like. It's hard or impossible to measure. An estimate might be off by a factor of 10 or by a factor of 1,000; there is no good way to know (Silver 2012). The next earthquake, bird flu outbreak, stock market crash, or oil tanker disaster, are all uncertainties.

Some risks are not worth taking.

Probabilities are Repeatable, Disasters are Not

The nature of disasters is that they are unique, unpredictable events. Catastrophes lie completely outside the set of conditions that contribute to probabilities. As such, we cannot make educated guesses about a future catastrophe from a series of events where catastrophes didn't happen. Yet this is what Kinder Morgan's risk analysis implies.

Knowing the true relationship between the possibility of an oil spill occurring and its potential harm (environmental, social, and economic) is essential for evaluating oil spill risk. Unfortunately, calculating risk on this scale is fraught with problems. Here, we examine the considerations that are not disclosed when Kinder Morgan conveys the risk presented by its project.

Statistics are Not Substitutions for a Lack of Data

We are all familiar with oil industry accidents—from oil rig explosions to grounded tankers, but we are less familiar with the underlying assumptions used to convey the unlikely nature of such events. Despite being portrayed as such, the probability of these events occurring cannot be accurately calculated with likelihoods such as 1 in 5,000 years (0.02%). o empirical data exists that could be used to predict such occurrences. But prior to these events occurring, we are provided with return periods and probabilities for how safe and unlikely these ventures are purported to be.

The Black Swan Event

Kinder Morgan's risk analysis relies on statistical probabilities that attempt to predict rare but potentially catastrophic events. Such events are known as Black Swans. 'Black Swan' occurrences are highly improbable events with three principal characteristics. They are unpredictable, carry a massive impact, and, after the fact, explanations are fabricated to make them appear less random and more predictable than they actually are (Taleb 2007).

In theory, making accurate predictions of future occurrences requires a longer period of observation—perhaps three times longer—than that being forecasted (Taleb 2008). Accordingly, in order for Kinder Morgan to make reliable predictions for a suggested 2,366 year return period (for a large oil spill), 7,098 years of historic shipping data would be required.

What is the Probability of an Oil Spill in the Salish Sea?

The Canadian portion of the Salish Sea ranks in Canada's highest risk category for accidents. Based on current traffic volumes

on the Pacific coast, the Canadian Federal Government's 2013 national marine spill risk assessment estimates an 800 year return period for a large spill of crude oil,[1] 272 years for a medium spill of a refined oil,[2] and only 23 years for a medium spill of fuel oil (Transport Canada 2013).

The Return Period of a Spill

Kinder Morgan's application to the NEB identifies return periods for various scenarios, which represent "credible worst case" scenarios. True worst case scenarios, like a shipping collision at Turn Point in Boundary Pass, are not considered. Even assuming Kinder Morgan's projections are accurate (which we do not), the Trans Mountain expansion would significantly increase the likelihood of a spill in the Salish Sea (Table 7.2)

What is a Return Period?

The probability of an oil spill occurring is calculated by oil companies using a 'return period'. A 100-year return period for an oil spill has a **1% chance of occurring each year** or a probability of 0.01 (a probability of 1 being certain). A 100-year return period does not mean one event every 100 years. An event can occur on the inaugural voyage, more than once, or not at all throughout these periods.

More Traffic—More Risk

Many shipping expansions are proposed for the Salish Sea. These include Delta Port and Terminal Two on Roberts Bank, plus coal, jet fuel and at least three LNG terminal proposals. All of these projects increase the potential for accidents through increased vessel traffic and the large volumes of oil they carry as fuel.

Against a 2010 baseline, an assessment of vessel traffic risk (VTRA) undertaken by the Puget Sound Partnership (Van Dorp and Merrick 2014) considered the impact of the Kinder Morgan expansion, Delta Port expansion, and Gateway Pacific expansion at Cherry Point (US) in terms of the volume of oil carried and the frequency and duration of vessel transits. The Kinder Morgan proposal increased predicted accident frequency by 5% and potential oil loss by 18%. When combined, these three pro-

Figure 7.1 Transport Canada's relative environmental risk index for a crude oil spill shows the Salish Sea as a very high-risk area (red) based on the existing level of traffic. Notably, this level of risk does not include significant increases in traffic from proposed expansions at Kinder Morgan, Delta Port, Roberts Bank, Fraser Surrey Docks, and the Discovery, Wood Fibre and WesPac Tilbery LNG developments (map: Transport Canada 2013).

1 > 63,000 barrels

2 6,300–63,000 barrels

Scenario	Oil Spill Volume (m3 / bbl.)	Return Period
2018 Baseline oil spill risk without TMX or improved safety measures		
Credible worst case	16,500 m3/104,000 bbl.	1 in 3,083 years
Any spill	> 0 m3/0 bbl.	1 in 309 years
Risk of oil spill from TMX traffic[1] without additional safety measures		
Credible worst case	16,500 m3/104,000 bbl.	1 in 456
Any spill	> 0 m3/0 bbl.	1 in 46
Risk of oil spill from TMX oil traffic with additional safety measures		
Credible worst case	16,500 m3/104,000 bbl.	1 in 2,366 years
Any spill	> 0 m3/0 bbl.	1 in 237 years

Table 7. 2 Kinder Morgan's predicted oil spill return periods with and without their Trans Mountain Expansion (TMX) project, and with and without additional safety measures (source: Kinder Morgan 2013).

[1] > 63,000 BARRELS

[2] 6,300–63,000 BARRELS

Freighters in English Bay.
PHOTO: W. LEIDENFROST

posals increase accident frequency and potential oil loss by 36% and 68%, respectively.

Kinder Morgan Fails to Evaluate Risk

Kinder Morgan's application to the NEB lacks a proper risk assessment and is inadequate for conveying the risk from marine oil spills. Although their spill modeling is more advanced than scenarios submitted by Enbridge (for the Northern Gateway proposal), the faults follow a similar pattern.

Critical aspects of the assessment are based on very limited biological information (i.e. they lack species abundance and distribution)—a crucial component of a risk assessment. In addition, many of the assumptions, methods, and analyses lack scientific rigor. Consequently, the results, conclusions, and recommendations are fraught with an unacceptable degree of uncertainty and are not supported by the information presented or the broader scientific literature.

"Trust Us" is Not Good Enough

The data and methods that Kinder Morgan used to estimate spill probabilities are considered proprietary and unavailable for independent review. Requests for information by Raincoast and others via the NEB hearing process have been denied (Kinder Morgan 2015),[3] and the hearing process itself omitted cross-examination of evidence. In addition, a key component of the assessment known as TERMPOL[4], a voluntary review of shipping safety, remains incomplete.

3 Raincoast NEB Information Request #2 to Kinder Morgan /TransMountain ULC

4 TERMPOL stand for Technical Review Process of Marine Terminal Systems and Trans-shipment Sites.

A Flawed Assessment of Risk

In assessing Kinder Morgan's proposal[5], internationally renowned oil spill expert Dr. Jeffrey Short concluded that Trans Mountain's Ecological Risk Assessment (ERA) was fundamentally flawed and should not be used to assess the ecosystem risks of the project (Short 2015). His findings include:

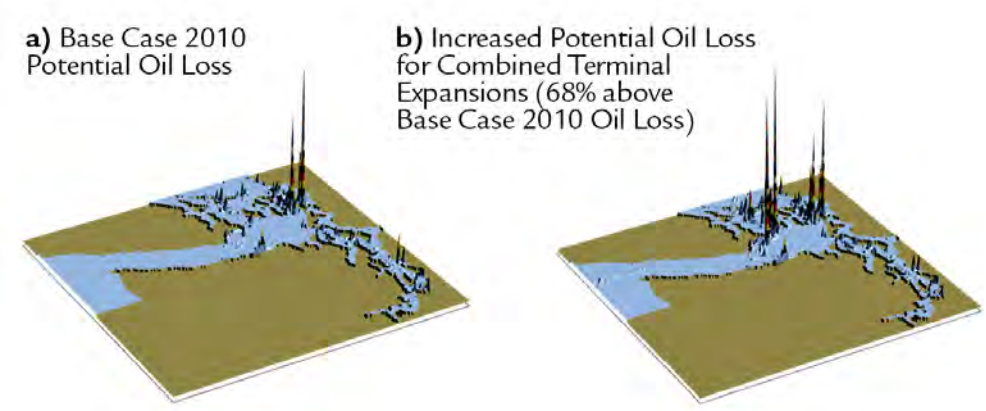


Figure 7.2 a): Potential oil loss in the Salish Sea for base case traffic in 2010; and panel (b): Potential oil loss in the Salish Sea associated with the Kinder Morgan, Pacific Gateway, and Delta Port terminal expansions (Van Dorp and Merrick 2014). **b):** Does not include risks from increased traffic to Terminal 2 at Roberts Bank, Fraser Surrey docks, Fraser River jet fuel terminal, WesPac-Tilbury, Wood Fibre or Discovery LNG.

1. The risk assessment only considered spills in a selected number of scenarios. The impact of spills in locations with higher consequences were not considered. This unreasonably eliminated much of the risk.
2. Probability and consequence were confounded. By considering only a select number of oil spill scenarios, Kinder Morgan assumed that species and habitats with a low probability of oil exposure (based on their proximity to a chosen oil spill scenario) had a low sensitivity to the consequences of oil exposure. This flaw alone invalidates Trans Mountain's risk assessment.
3. Kinder Morgan assumes dilbit will not sink or submerge.

Kinder Morgan disregards the impacts of submerged oil on a range of species with commercial and subsistence values such as shellfish, Pacific herring, and salmon. The assumption that dilbit will float is contrary to their own submission, as well as studies and experience that identify the conditions under which dilbit can sink. For example, the presence of freshwater and sediment in both Burrard Inlet and the Fraser River estuary could cause diluted bitumen to sink.

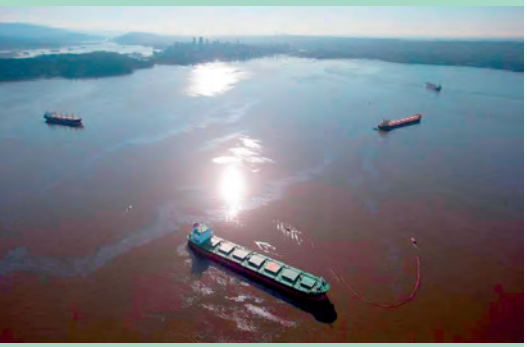
Spinning the Roulette Wheel

Each time oil tankers cross through the Salish Sea we spin an imaginary roulette wheel. Kinder Morgan's expansion proposal ups the stakes. An assessment done by analysts at Simon Fraser University indicates this roulette wheel has 90 numbers (Gunton et al. 2015). How many times should we spin the wheel for purported economic benefits, in the hope number 90 never comes in?

5 On behalf of the City of Vancouver, the Tsleil-Waututh First Nation and Living Oceans Society

For the Birds
Trans Mountain's ecological risk assessment mistakenly claims that shorebirds and birds that wade are not present in large numbers and are widely distributed. In fact, the Fraser River estuary supports some of the highest densities and numbers of these birds within the western hemisphere. Counts of western sandpipers alone—one species of shorebird that uses the Fraser River estuary on its migration—range from 500,000 to one million birds annually (Short 2015).

PHOTO: R. BUTLER



Accidents Happen
Vancouver's Marathassa oil spill occurred on a calm spring day in 2015 on the vessel's maiden voyage. The incident was characterized by major communication and response failings by the Canadian Coast Guard, despite their claims to the contrary.

PHOTO: D. DYCK, CANADIAN PRESS

World-class Spill Response?

A key factor in assessing the consequence of an oil spill is the effectiveness of spill response. The province of British Columbia's latest marine spill response studies (Nuka Research 2013) show that 6 days after a diluted bitumen spill, 56% of the oil would remain on the water, with 13% having dispersed or evaporated and 31% recovered.

The report qualifies the limitations on the oil recovery, including the fact that spill response measures would not be effective in some of the sea states that occur in the Juan de Fuca strait. Perhaps more significantly, the report highlights that diluted bitumen is "poorly understood" and that the model did not account for potential sinking or submergence. Were this to occur, no proven recovery methods exist.

Could Raincoast do a Better Risk Assessment?

Without quantitative data on the distribution and abundance of marine birds and marine mammals in the Salish Sea, a proper and dependable risk assessment cannot be conducted. Although Kinder Morgan has conducted a range of spill scenarios, these are inadequate for decision-making. Simply showing the overlap between a spill scenario and a range of biological or recreational features would better convey the values that are at risk.

An oil spill could occur anywhere along the proposed tanker route as it transits the Salish Sea. This report only considers one spill scenario, Turn Point. Yet, spills could occur in Burrard Inlet, English Bay, the mouth of the Fraser River, or the Strait of Juan de Fuca, one or multiple times.

We have used Kinder Morgan's oil spill modelling from their 2013 application to the NEB to illustrate the probability of a given location being affected by an oil spill. Turn Point is an area with navigational challenges and high vessel traffic.

Significant Impact, even without a Spill

Although the threat from oil spills is a large concern, Kinder Morgan's project would have significant adverse affects on Southern Resident killer whales regardless of an oil spill. Even Kinder Morgan acknowledges that the increased underwater noise from its tankers[1] on Southern Resident killer whales "is considered to be high magnitude, high probability and significant" (Kinder Morgan 2013).

PHOTO: S. VEIRS, BEAMREACH

1 And associated vessels; these include escort and assistance tugs, pilot vessels, and potentially tugs and barges.

The Consequence of an Oil Spill—What's at Stake

The Southern Resident Killer Whales

One of region's most valued biological assets are the Southern Resident killer whales. We have overlaid their critical habitat—areas where they hunt, feed and raise their young—with the results of Kinder Morgan's oil spill scenario near Turn Point at the northern end of Haro Strait (Figure 7.3). Kinder Morgan's model is based on fall conditions and only runs for 15 days. Experience from the *Exxon Valdez* oil spill was that oil travelled away from Bligh Reef (accident site) for at least 56 days.

Figure 7.3 shows that a large oil spill near Turn Point has a 95% chance of exposing resident killer whales if they are anywhere near Haro Strait or the eastern end of the Juan de Fuca at the time. There is a 60% chance of surface oiling within a 3,800 km^2 area centered on Haro Strait after a spill at Turn Point. Haro Strait is one of the most routinely travelled areas in the Salish Sea for resident killer whales.

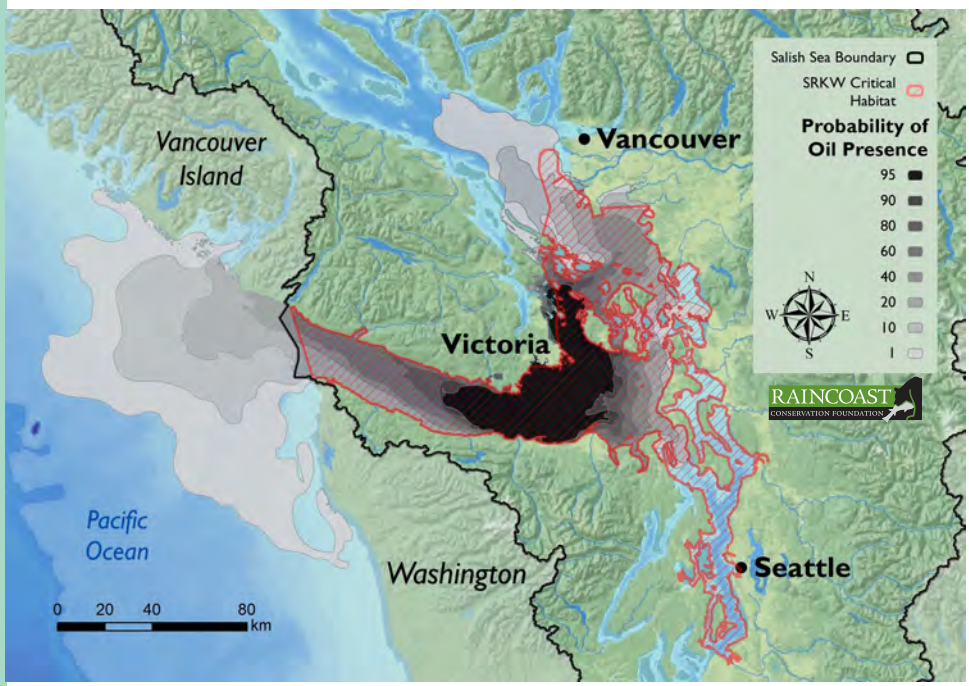


Figure 7.3 Black to grey shading indicates the probability of oil presence within the first 15 days of an oil spill near Turn Point (yellow star) in the fall, according to Kinder Morgan. This scenario is overlaid with the critical habitat for Southern Resident killer whales.

Probability of Oil Presence (%)	Total Overlap Area (km2)	Critical Habitat Impacted (km2)
1	7107	80%
10	6652	75%
20	5985	67%
40	4831	54%
60	3785	43%
80	2687	30%
90	2205	25%
95	1962	22%

Table 7.3 Spatial overlap between areas with a probability of oil presence (based on Kinder Morgan's Turn Point oil spill scenario) and the critical habitat of Southern Resident killer whales.

Turn Down the Volume

The threat to killer whales isn't just from oil spills. Noise from ships reduces the distance at which whales can hear each other. Studies show that killer whales loose more than half of their communication space in the presence of ships, and loose almost all (97%) during heavy traffic (Clark 2015). Singing humpback whales can similarly lose more than half of their communication space under average noise conditions and up to 80% during the noisiest times (Williams et al. 2014).

PHOTO: B. HARVEY

Whales Need to Hear and Be Heard

It's not just the direct impacts of an oil spill that can be a problem for the Southern Resident killer whales. Communication space is the area within which a whale can hear and be heard by others. This space decreases with the introduction of human generated sounds, like shipping. Both killer whales and humpback whales have already lost substantial proportions of their communication space in Haro Strait to shipping noise (Williams et al. 2013, Williams et al. 2014). To put this into perspective, a killer whale call that might normally be heard by other whales 8 km away could fill a communication space of 200 km^2. When ships are present, the average area over which this killer whale will be heard shrinks to 75 km^2. At the noisiest times, its call fills only 6 km^2 (AEI 2013, Williams et al. 2013). Reducing a whale's communication space can then require more energy for hunting and communication, or cause a heightened state of alertness (and stress) (AIE 2013).

Oil Spills Leave a Mark on Coastal Tourism

The *Deepwater Horizon* spill provides a recent example of the impact of oil spills on coastal tourism. One-quarter of the people planning to visit Louisiana cancelled or postponed after the spill began (Louisiana Travel 2010). Studies specifically focused on the hospitality industry found that two weeks after the spill began, 35% of regional hotels had cancellations, with 60% four

weeks into the spill (Knowland Group 2010). A report by Oxford Economic (2010) estimated the potential economic impact to US coastal economics as $22.7 billion (US) over three years.

After the *Exxon Valdez* spill more than 40% of regional businesses reported significant or complete losses; $19 million in visitor spending was lost in one season (Oxford Economics 2010). Similarly in Spain, Galician tourism was reduced by more than 133 million Euros after the *Prestige* oil spill (Garza-Gil et al. 2005). With regard to Kinder Morgan's Trans Mountain proposal, the City of Vancouver estimated the economic impact of a large oil spill in Vancouver's Burrard Inlet could exceed $2 billion (City of Vancouver, 2015).

Importantly, studies indicate that long-term effects of oil spills on fisheries and related environmental resources can significantly affect associated sectors including tourism. These losses can be greater than direct economic losses, especially for adjacent regions not directly affected by a spill (Sumaila et al. 2012 EVOSTC 2010, Ott 2005).

What Do We Stand to Gain? Economic Myths and Realities

Jobs in the tourism sector employ well over 250,000 BC and Washington State residents and a range of species—including killer whales, other marine mammals and marine birds, are of vital importance to the regional ecotourism economy (see Chapter 4).

The risk presented by Kinder Morgan's oil tanker expansion should be weighed against the purported benefits. Kinder Morgan claims the project will provide 90 permanent jobs upon completion. The project also requires expansion of Alberta's tar sands, an activity heralded as a large boon to the Canadian economy.

The overt support by the Federal Government for the development of the tar sands would suggest that the industry is at the core of the Canadian economy. In reality however, the numbers do not support this—either within BC or at a national level. Based on 2007 data, the tar sands make up only 2% of Canadian

Whale Watching

Our studies indicate a Salish Sea whale watching sector with annual revenues between $17 and $24 million and employing up to 360 people in the summer.

PHOTO: B. HARVEY

Boating

A significant proportion of boat launches (WA) and marinas (BC) fall within the area affected by oil. The extent of a spill would drastically restrict recreational use within the oiled area.

PHOTO: D. STONE, TIMES COLONIST

GDP (CRED 2014) and using 2014 data the entire mining, quarrying, and oil and gas extraction industries employed an estimated 1.7% of the Canadian work force in 2014 (Statistics Canada 2014).

Within BC, over 94,000 Canadian birding visitors and 322,000 US visitors come to the province for the birds (Tourism BC 2009).

Using studies that calculate direct and induced expenditure, the Salish Sea birding sector generates more than $1.3 billion in expenditures and supports more than 24,000 jobs. A single spill scenario indicates that the effects could be devastating.

PHOTO: B. HARVEY

At What Price?

Attaching a dollar value to the damage that spilled oil has on ecosystems is impossible. The monetary cost of the *Exxon Valdez* spill is estimated at US $9.5 billion of which Exxon has paid $3.5 billion; taxpayers paid the remainder. British Petroleum claims to have spent US $14 billion on clean-up and restoration in the first two years following the *Deepwater Horizon* oil spill, but the true costs are unknown. Scientists have speculated that the full environmental consequences will not be understood for decades because the toxic effects from the huge volumes of dispersed oil are presently unknown (Gaskill 2011).

But the question remains: can money truly replace the functional or total loss of a marine species, a productive ecosystem, or the demise of a coastal community's way of life?

From Raincoast's perspective, species and wild places warrant protection, regardless of the utilitarian value that healthy environments provide for people. Nonetheless, values compel us to safeguard species, including humans; all of which depend upon a healthy and ecologically rich environment (Bearzi 2009).

Failure to reconcile ecology and commerce has been a hallmark of domestic and international policy for decades. This is because a fundamental conflict exists between economic growth and conservation (Trauger et al. 2003). As the economy grows, natural capital (such as forests, river banks, soil, and water) is reallocated from wildlife habitat to the human economy. Some believe technological progress may reconcile this conflict, but most technological progress expands the breadth of the human niche and, when primarily in the service of economic growth, only exacerbates the conflict (Czech and Daly 2004).

The concerns we have are not new, nor are the problems that precipitated them. They are, however, a powerful argument in

Surfing

The vast majority of regional surf locations are situated in areas that could be affected by a spill originating at Turn Point.

PHOTO: PACSAFE

Sea Kayaking

The Salish Sea kayaking sector has annual revenues of $20 million, provides 375 year round jobs, and 630 jobs in the summer season.

PHOTO: OCEAN RIVER ADVENTURES

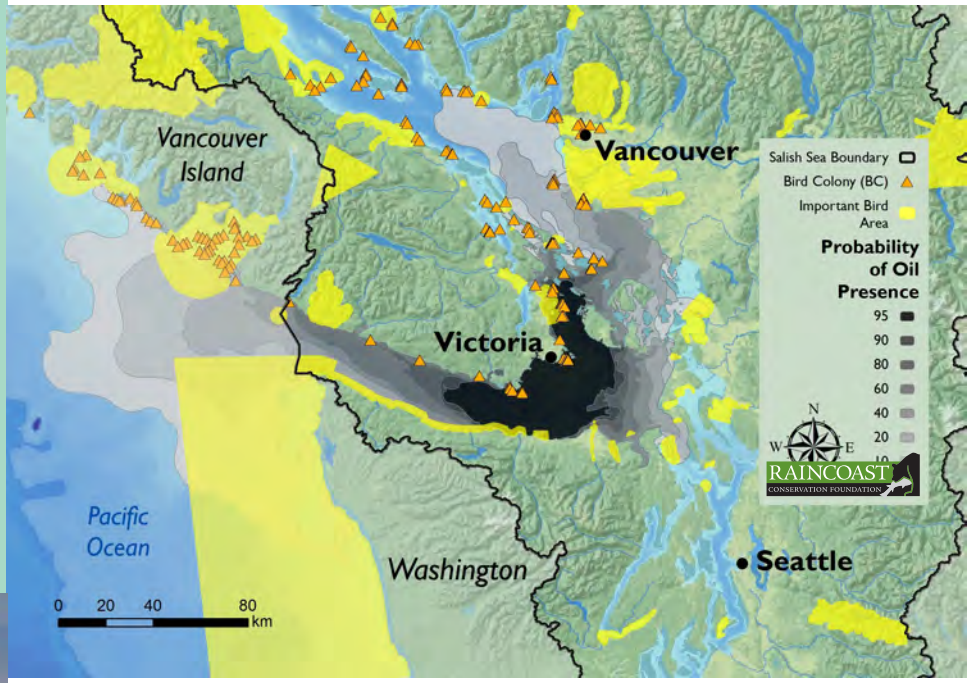


Figure 7.4 Black to grey shading shows the probability of oil presence within the first 15 days of an oil spill accident near Turn Point in the Fall, according to scenarios compiled by Kinder Morgan. This scenario is overlaid with Important Bird Areas and colonies within the Salish Sea.

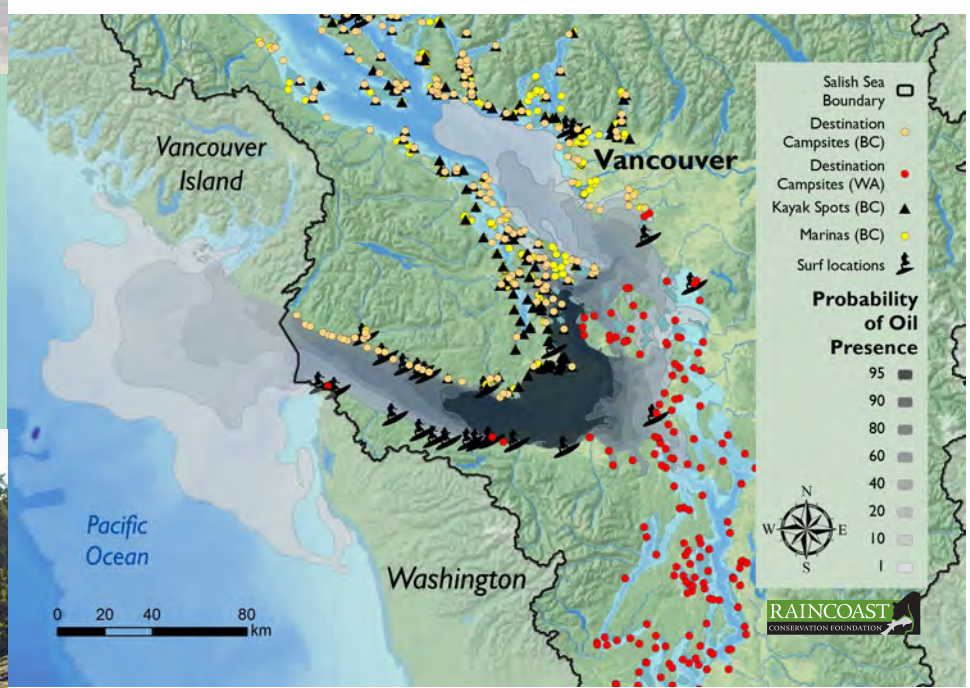


Figure 7.5 Black to grey shading shows the probability of oil presence within the first 15 days of an oil spill near Turn Point in the fall, according to scenarios compiled by Kinder Morgan. This scenario is overlaid with surf locations, kayak landings, coastal camp sites, and marinas.

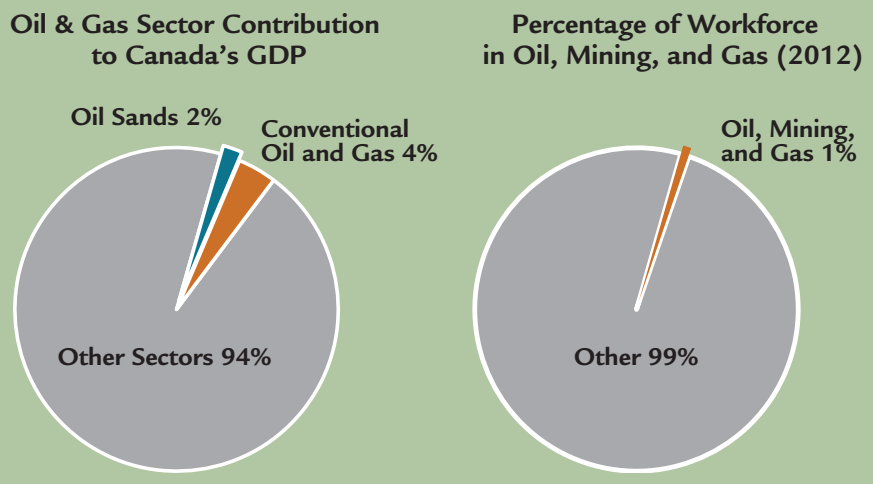


Figure 7.6 a) Using 2007 data, the Canadian oil sands contributed only 2% to national GDP (CRED 2014); **b)** In BC, oil, mining and gas make up 1% of BC's workforce (BC Ministry of Finance 2012).

The Energy Sector and the BC Economy

Contrary to what many believe, the energy sector is not a key driver of the BC economy. Measured in GDP, oil, gas, and support services contributed only 3% of BC's GDP, which is significantly less than financial and real estate (23%), construction, (8%), and manufacturing (7%) (CRED 2014). Measured in jobs, the oil, mining, and gas sector employed only 1% of the BC's workforce in 2012 (BC Ministry of Finance 2012).

favour of a radically different course of action. Solutions to our energy problems are everywhere if we make the collective, individual, and political choices to implement them. In fact, renewable energy alternatives (primarily sun and wind) are coming on line so fast they have grossly outstripped the International Energy Agency's (IEA) predictions for the amount of gigawatt power that would be generated by renewables to date (Boyd 2015). In fact, China alone is now adding more solar-based electricity every six months than the IEA's predicted 2020 total for the entire world (Boyd 2015).

Opening more doors to these solutions begins with saying 'no' to converting our coast to an energy corridor and being the catalyst for the unbridled exploitation of our land, oceans, freshwater, and climate that accompanies tar sands extraction. From here, other protective and restorative actions can be taken, so the priceless and irreplaceable BC coast can continue its unparalleled evolutionary journey.