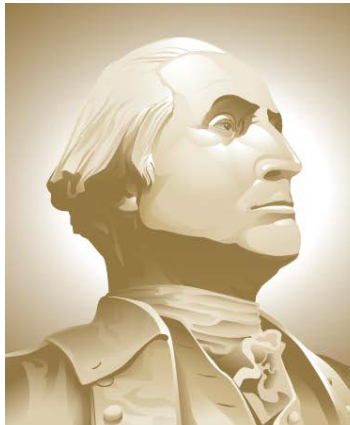


VTRA 2010 – BASE CASE GEOGRAPHIC PROFILES BY POTENTIAL SPILL SIZE– **SUPPLEMENTAL ANALYSIS**



**THE GEORGE
WASHINGTON
UNIVERSITY**

WASHINGTON, DC

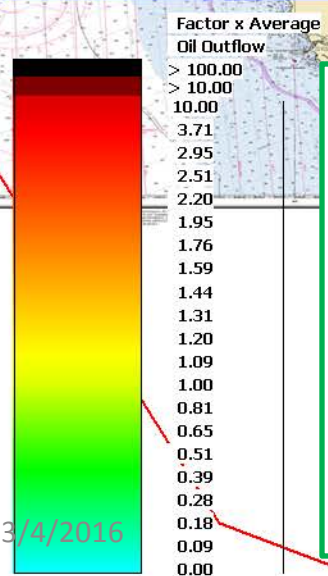
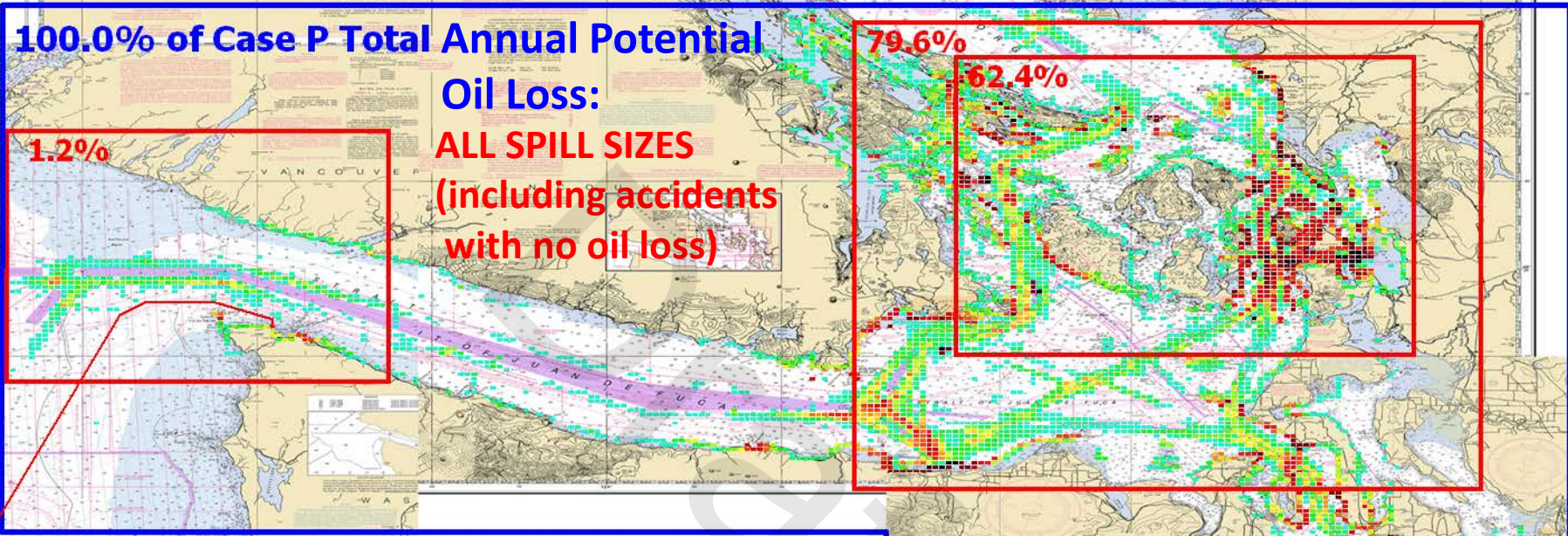
VCU

Jason R.W. Merrick (VCU) and Rene van Dorp (GW)

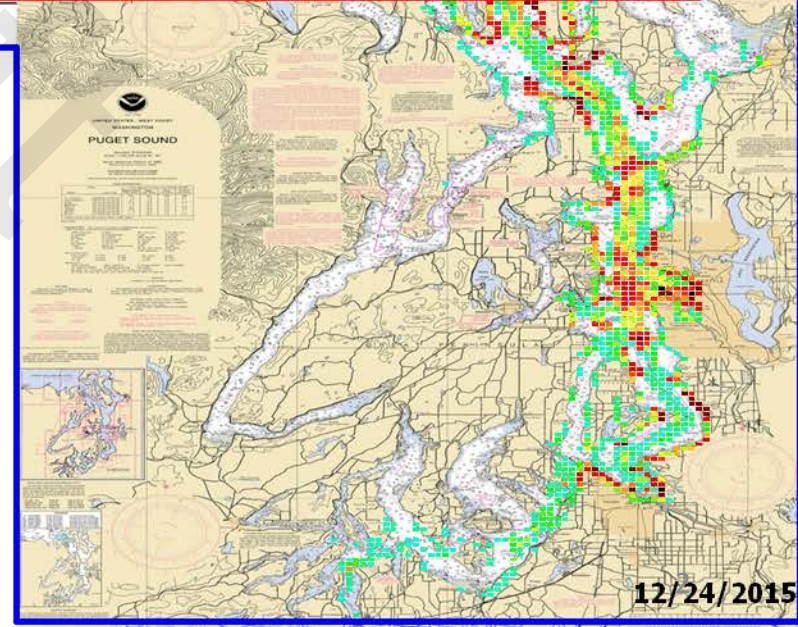
March 2nd, 2016

VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2010

P: VTRA 2010 - BASE CASE - ALL FV



P: BASE CASE 2010
VTRA 2010 GEOGRAPHIC PROFILE OF ANNUAL POTENTIAL OIL LOSS OF ACCIDENTS IN SPILL SIZE CATEGORY ALL SPILL SIZES



3/4/2016

12/24/2015

BASE CASE 2010 PERCENT CONTRIBUTION TO ANNUAL POTENTIAL OIL SPILL AND ANNUAL POTENTIAL ACCIDENT FREQUENCY BY SPILL SIZE
(NOTE THIS INCLUDES ACCIDENTS WITH NO OIL LOSS, MAY 26, 2015 ANALYSIS ONLY CONSIDERED THOSE WITH SOME OIL LOSS)

VTRA 2010	OIL_2500_MORE	OIL_1000_2500	OIL_1_1000	OIL_0_1
% Potential Annual Oil Loss	53.3%	14.0%	32.1%	0.6%
% Potential Annual Accident Frequency	0.03%	0.03%	1.8%	98.1%
Average potential spill size per accident (in m ³)	6,559	1,711	65	0.02
Probability of an accident in 25 years by spill size	3.1%	3.2%	85.6%	100.0%

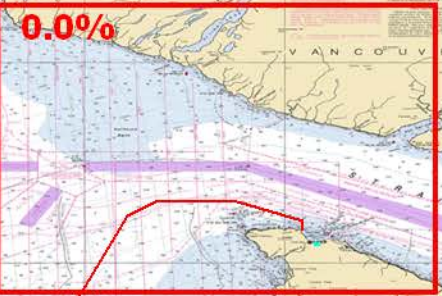
98.1 % of Potential Annual Accident Freq. involves accidents in the 0 – 1 m³ oil loss Category contributing to 0.6% of Potential Annual Oil Loss

Probability estimate of an accident in 25 years in the 0 – 1 m³ oil loss category equals about 1. (with an average of 0.02 m³ ≈ 5 gallons, which includes those accidents with no oil loss at all)

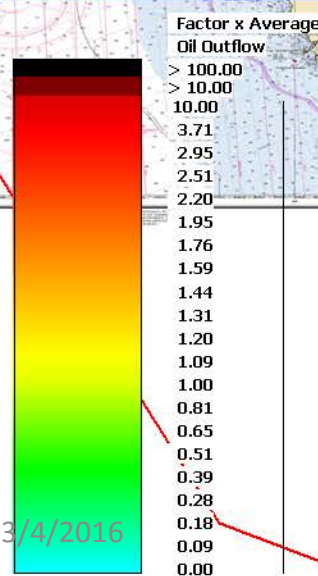
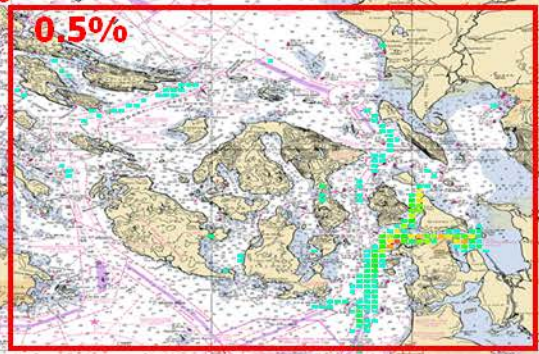
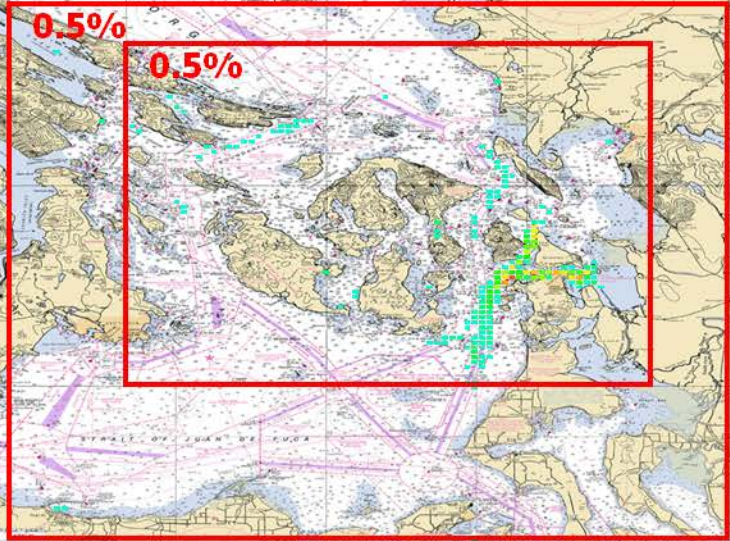
VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2010

P: VTRA 2010 - BASE CASE - ALL FV

0.6% of Case P Total Annual Potential Oil Loss:



SPILL SIZES BETWEEN 0 m³ - 1 m³ including those with no oil loss



P: BASE CASE 2010
VTRA 2010 GEOGRAPHIC PROFILE OF ANNUAL POTENTIAL OIL LOSS OF ACCIDENTS IN SPILL SIZE CATEGORY BETWEEN 0 m³ - 1 m³

98.1% of Potential Annual Accident Frequency

Prob. Estimate of Spill Occur. of this type in 25 years equals 1

Average of 0.02 m³ Per Potential Spill (≈ 5 gallons)

BASE CASE 2010 PERCENT CONTRIBUTION TO ANNUAL POTENTIAL OIL SPILL AND ANNUAL POTENTIAL ACCIDENT FREQUENCY
(NOTE THIS INCLUDES ACCIDENTS WITH NO OIL SPILL, MAY 26, 2015 ANALYSIS ONLY CONSIDER THOSE WITH SOME OIL SPILL)

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1.8 % of Potential Annual Accident Freq. involves accidents in the 1 – 1000 m³ oil loss Category contributing to 32.1% of Potential Annual Oil Loss

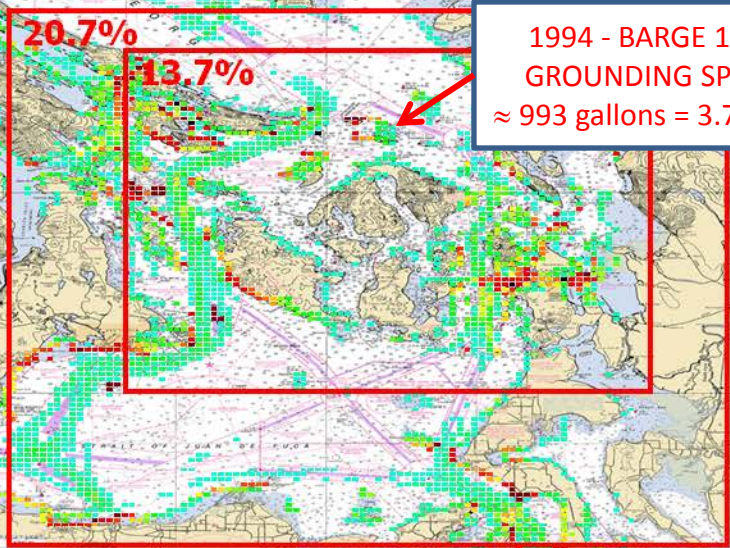
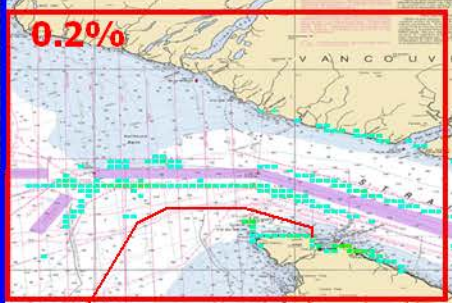
85.6% Prob. Estimate of an Accident in 25 years with a Potential Spill Size between 1 m³ - 1000 m³ (and an Average of 65m³ per potential spill ≈ 410 barrels)

VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2010

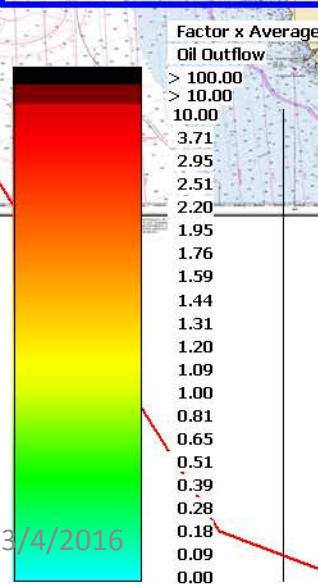
P: VTRA 2010 - BASE CASE - ALL FV

32.1% of Case P Total Annual Potential Oil Loss

**Oil Loss:
SPILL SIZES BETWEEN
1 m³ - 1,000 m³**



1994 - BARGE 101
GROUNDING SPILL
≈ 993 gallons = 3.75 m³



P: BASE CASE 2010
VTRA 2010 GEOGRAPHIC PROFILE OF ANNUAL POTENTIAL OIL LOSS OF ACCIDENTS IN SPILL SIZE CATEGORY
1 m³ - 1000 m³

1.8% of Potential Annual Accident Frequency

Prob. Est. of Spill Occur. of this type in 25 yrs equals 85.6%

Average of 65 m³ Per Potential Spill (= 17,209 gallons)

BASE CASE 2010 PERCENT CONTRIBUTION TO ANNUAL POTENTIAL OIL SPILL AND ANNUAL POTENTIAL ACCIDENT FREQUENCY
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Average potential spill size per accident (in m ³)	6,559	1,711	65	0.02
Probability of an accident in 25 years by spill size	3.1%	3.2%	85.6%	100.0%

0.03 % of Potential Annual Accident Freq. involves accidents in the 1000 m³ – 2500 m³ oil loss Category contributing to 14.0% of Potential Annual Oil Loss

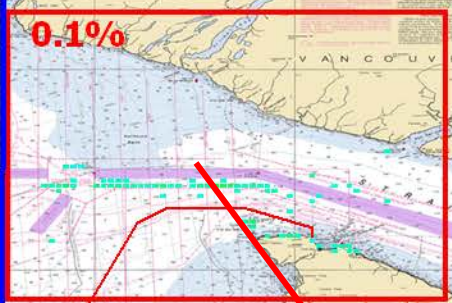
3.2% Prob. Estimate of an Accident in 25 years with a Potential Spill Size between 1000 m³ - 2500 m³ (and an Average of 1711m³ per potential spill ≈ 1,471 metric tons)

VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2010

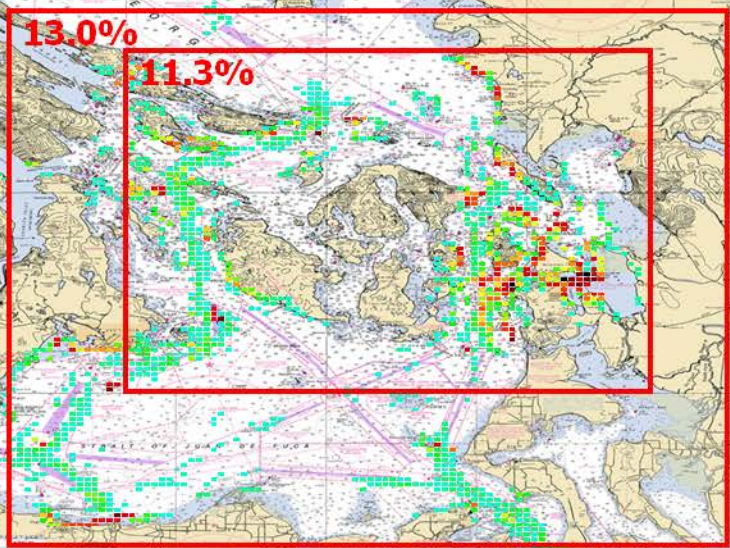
P: VTRA 2010 - BASE CASE - ALL FV

14.0% of Case P Total Annual Potential Oil Loss

Oil Loss: SPILL SIZES BETWEEN 1,000 m³ - 2,500 m³



TENYO MARU – TUO HAI COLLISION SPILL 1991
≈ 361,000 gallons = 1,367 m³



P: BASE CASE 2010
VTRA 2010 GEOGRAPHIC PROFILE OF POTENTIAL ANNUAL OIL LOSS OF ACCIDENTS IN SPILL SIZE CATEGORY 1,000 m³ - 2,500 m³

0.03% of Potential Annual Accident Frequency

Prob. Est. of Spill Occur. of this type in 25 yrs equals 2.6%

Average of 1,711 m³ Per Potential Spill (≈ 1,471 metric tons)

BASE CASE 2010 PERCENT CONTRIBUTION TO ANNUAL POTENTIAL OIL SPILL AND ANNUAL POTENTIAL ACCIDENT FREQUENCY
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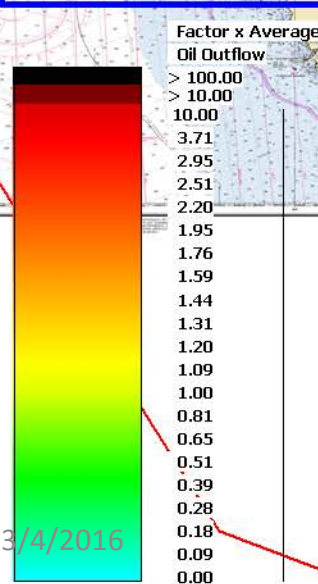
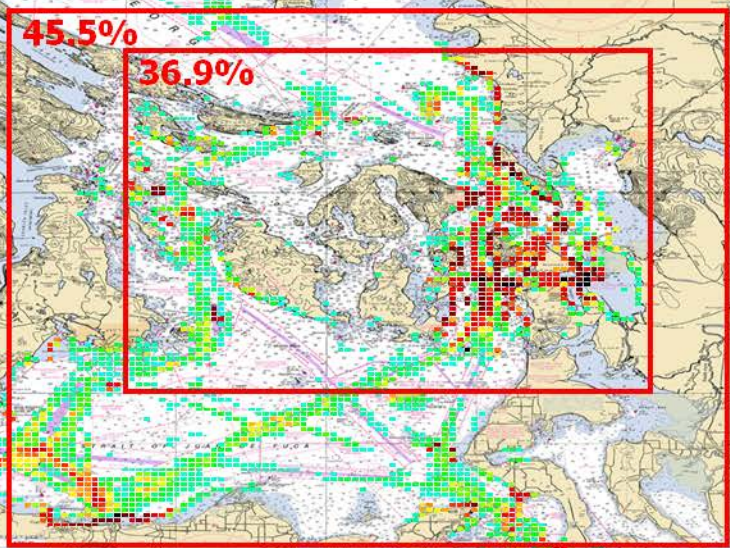
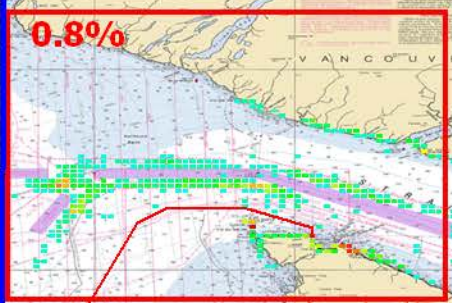
0.03 % of Potential Annual Accident Freq. involves accidents in the 2500 m³ or more Oil Loss Category contributing to 53.3% of Potential Annual Oil Loss

3.1% Prob. Estimate of an Accident in the 25 years with a Potential Spill Size of 2500 m³ or more (and an Average of 6,559m³ per potential spill ≈ 5,640 metric tons)

VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2010

P: VTRA 2010 - BASE CASE - ALL FV

53.3% of Case P Total Annual Potential Oil Loss:
SPILL SIZES LARGER THAN 2,500 m³



P: BASE CASE 2010
VTRA 2010 GEOGRAPHIC PROFILE OF POTENTIAL ANNUAL OIL LOSS OF ACCIDENTS IN SPILL SIZE CATEGORY **LARGER THAN – 2,500 m³**

0.03% of Potential Annual Accident Frequency

Prob. Est. of Spill Occur. of this type in 25 yrs equals 3.6%

Average of 6,559 m³ Per Potential Spill (≈ 5,640 metric tons)

3/4/2016

12/24/2015

QUESTIONS?