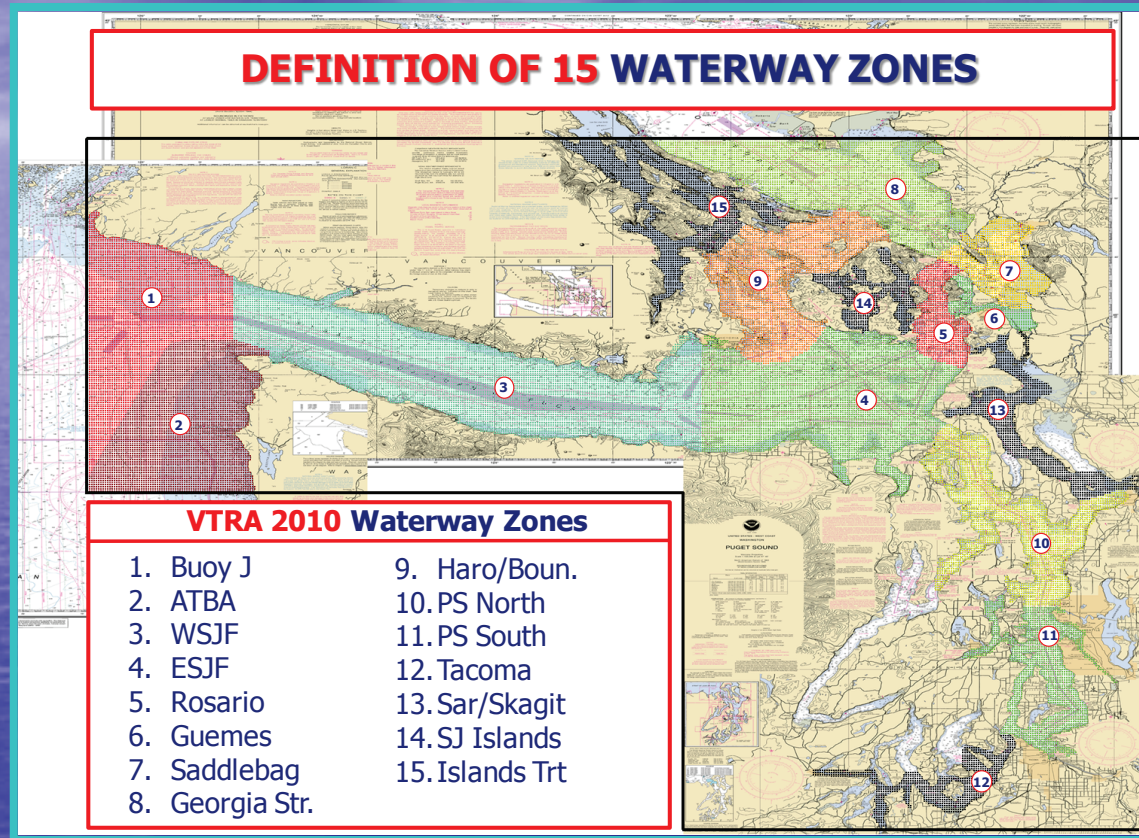


VTRA 2010 – SYNOPSIS OF HIGH SCENARIO COMPARISON APPLIED TO CASE P: BASE CASE



GWU Personnel: Dr. J. Rene van Dorp

VCU Personnel: Dr. Jason R. W. Merrick

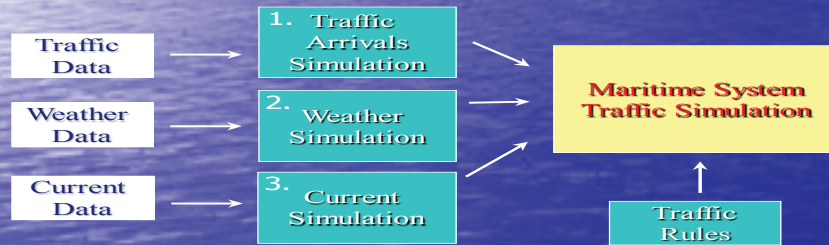
FOCUS VESSELS TRAVEL THROUGH VTRA STUDY AREA

Focus Vessels: Tanker, ATB, Chem. Carrier, Oil Barge, Bulk Carrier, Container Vessel and Other Cargo Vessels

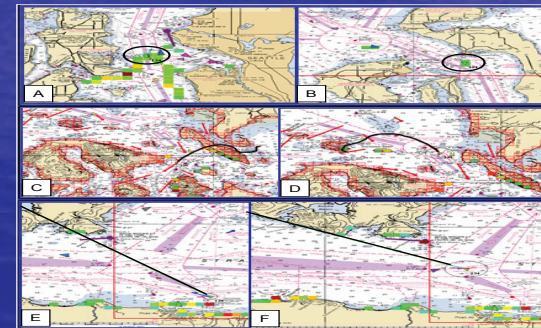
We developed a vessel traffic movement modeled largely based on VTOSS 2010 data validated using AIS 2010 data. We consider the 2010 traffic model a base case year and denote it scenario **P – BASE CASE**.

We add vessel traffic to 2010 traffic model to mimic what-if scenarios and we compare them to the base case year.

SNAPSHOTS OF KEY VTRA MODEL COMPONENTS



Required close cooperation with the USCG VTS and Puget Sound Harbor Safety Committee for data + validation



Generating Accident Scenarios:

Counting Collision Accident Scenario's

Counting Drift Grounding Accident Scenario's

Counting Powered Grounding Accident Scenario's

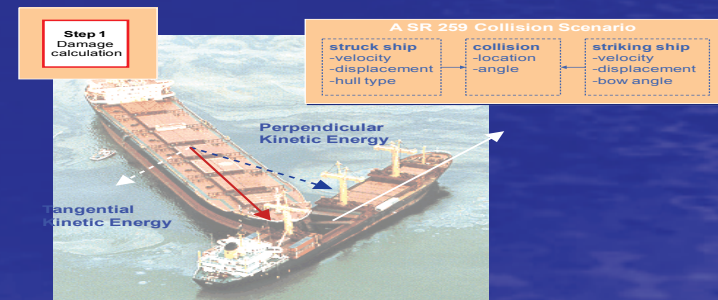
77

Conduct Expert Judgment Elicitations via Questionnaires

Q30		
Situation 1	TANKER DESCRIPTION	Situation 2
Straits of Juan de Fuca East	Location	
	Inbound Direction	
	Laden Cargo	
	1 Escort	
	Untethered	
Shallow Draft Pass. Vessel	Tethering	
	INTERACTING VESSEL	
	Vessel Type	
	Traffic Scenario	
	Traffic Proximity	
Crossing the Bow	WATERWAY CONDITIONS	
	Visibility	
	Wind Direction	
	Wind Speed	
	Current	
Less than 1 mile	Along Vessel	
	Almost Slack	
	Along Vessel - Opposite Direction	
	More?	
	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	
Situation 1 is worse		Situation 2 is worse

Example of potential experts: USCG VTS Operators, Puget Sound Pilots, Tanker Captains and First Mates, Tug Captains and First Mates, etc.

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P – BC & HIGH TANKERS

BASE CASE 2010 TRAFFIC WITH

HIGH TANKER CASE – RIGHT COLUMN

TANKER CALL NUMBER HIGH-LOW ANALYSIS FROM 1998-2012

	LOW - YEAR: - #	2010	HIGH - YEAR: + #
CHERRY POINT	193 - 1998 : -136	329	398 - 2007 : +69
ANACORTES	184 - 1998 : -58	242	319 - 2007 : +77
FERNDAL	118 - 1998 : 3	115	111 - 2007 : -+4
Total Change Tank FV	-191		+150

P – BC & HIGH TANKER AND CARGO FV

BASE CASE 2010 TRAFFIC WITH HIGH TANKERS AND

HIGH CARGO FOCUS VESSELS – RIGHT COLUMN

BULK TRANSIT NUMBER HIGH-LOW ANALYSIS FROM 2008-2012

	LOW - YEAR: - #	2010	HIGH - YEAR: + #
Bouy J - Georgia Strait	1095 - 2009 : -63	1159	1268 - 2011 : +109
Bouy J - Puget Sound	344 - 2009 : 22	322	325 - 2011 : +3
Puget Sound - Georgia Strait	0 - 2009 : +0	0	0 - 2011 : +0
Total Change Bulk FV	-41		+112

CONTAINER TRANSIT NUMBER HIGH-LOW ANALYSIS FROM 2008-2012

	LOW - YEAR: - #	2010	HIGH - YEAR: + #
Bouy J - Georgia Strait	223 - 2009 : -85	308	332 - 2011 : +25
Bouy J - Puget Sound	812 - 2009 : +46	766	807 - 2011 : +41
Puget Sound - Georgia Strait	274 - 2009 : +52	222	258 - 2011 : +36
Total Change Container FV	+13		+102

OTHER CARGO TRANSIT NUMBER HIGH-LOW ANALYSIS FROM 2008-2012

	LOW - YEAR: - #	2010	HIGH - YEAR: + #
Bouy J - Georgia Strait	336 - 2009 : -50	386	421 - 2011 : +36
Bouy J - Puget Sound	280 - 2009 : +28	252	255 - 2011 : +3
Puget Sound - Georgia Strait	246 - 2009 : +20	226	260 - 2011 : +34
Total Change Other Cargo FV	-2		+73

EXPOSURE DEFINITIONS

VESSEL TIME EXPOSURE:

TOTAL AMOUNT OF ANNUAL TIME A FOCUS VESSEL IS MOVING THROUGH THE VTRA STUDY AREA

FUEL OIL TIME EXPOSURE:

TOTAL AMOUNT OF ANNUAL TIME A CUBIC METER OF FOCUS VESSEL FUEL OIL IS MOVING THROUGH THE VTRA STUDY AREA

CARGO OIL TIME EXPOSURE:

TOTAL AMOUNT OF ANNUAL TIME A CUBIC METER OF FOCUS VESSEL CARGO (CRUDE + PRODUCT) OIL IS MOVING THROUGH THE VTRA STUDY AREA

FOCUS VESSELS MOVE OIL: Crude, Product and Fuel

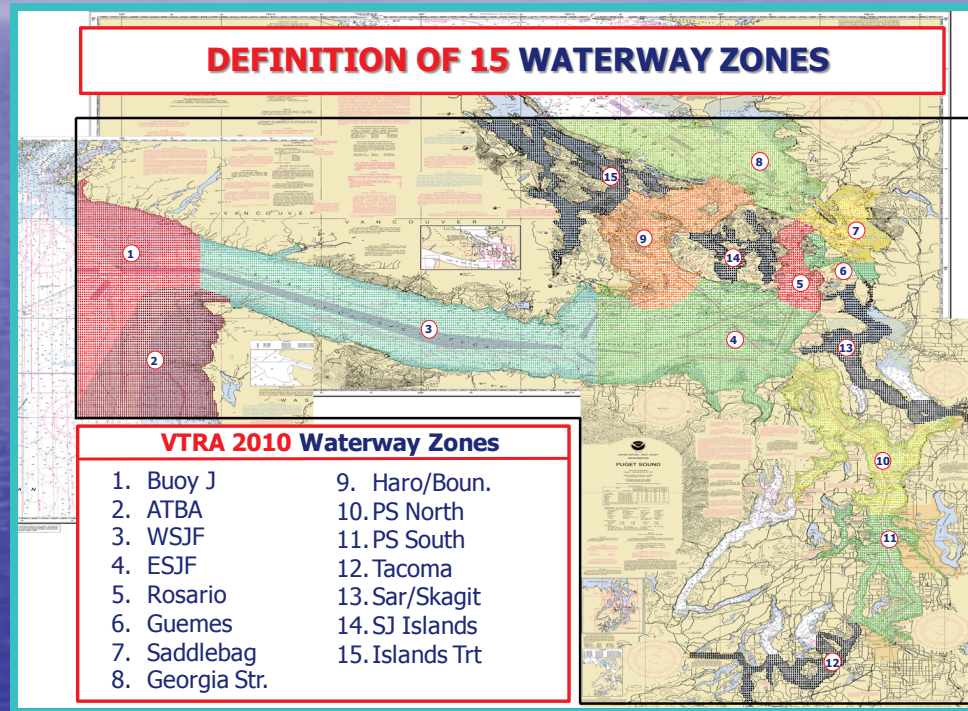
Disclaimer: No information is available on volume of oil or type of oil on board a vessel and we have to rely on overarching assumptions regarding movement of amount and type of oil as focus vessels move through the study area.

- Assumption 1 : Tankers are classified as crude or product carriers by name
- Assumption 2 : Chemical carriers transport product.
- Assumption 3 : Oil barges are assumed to transport product.
- Assumption 4 : All Focus Vessels fuel tanks are 50% full
- Assumption 5 : US bound crude tankers are assumed fully laden as they arrive in study area, drop of equal amounts at their stops and leave empty.
- Assumption 6 : Canadian bound crude tankers are assumed empty as they arrive and fully laden as they depart.
- Assumption 7 : Product Tankers and ATB's are assumed fully laden as they depart study area, empty as they arrive.
- Assumption 8 : Chemical carriers are assumed fully laden as they arrive in the study area, empty when they leave the study area.
- Assumption 9 : When ATB's go back and forth between two destinations within the study area they are assumed 50% full
- Assumption 10: Oil barges are assumed fully laden as they travel through study area.
- Assumption 11: Tank Focus Vessels not covered by 1-10 are assumed fully laden.

VTRA 2010 – SYNOPSIS OF 3D SCENARIO COMPARISON

VESSEL TIME EXPOSURE

By What-if Focus Vessels and Base Case Focus Vessels



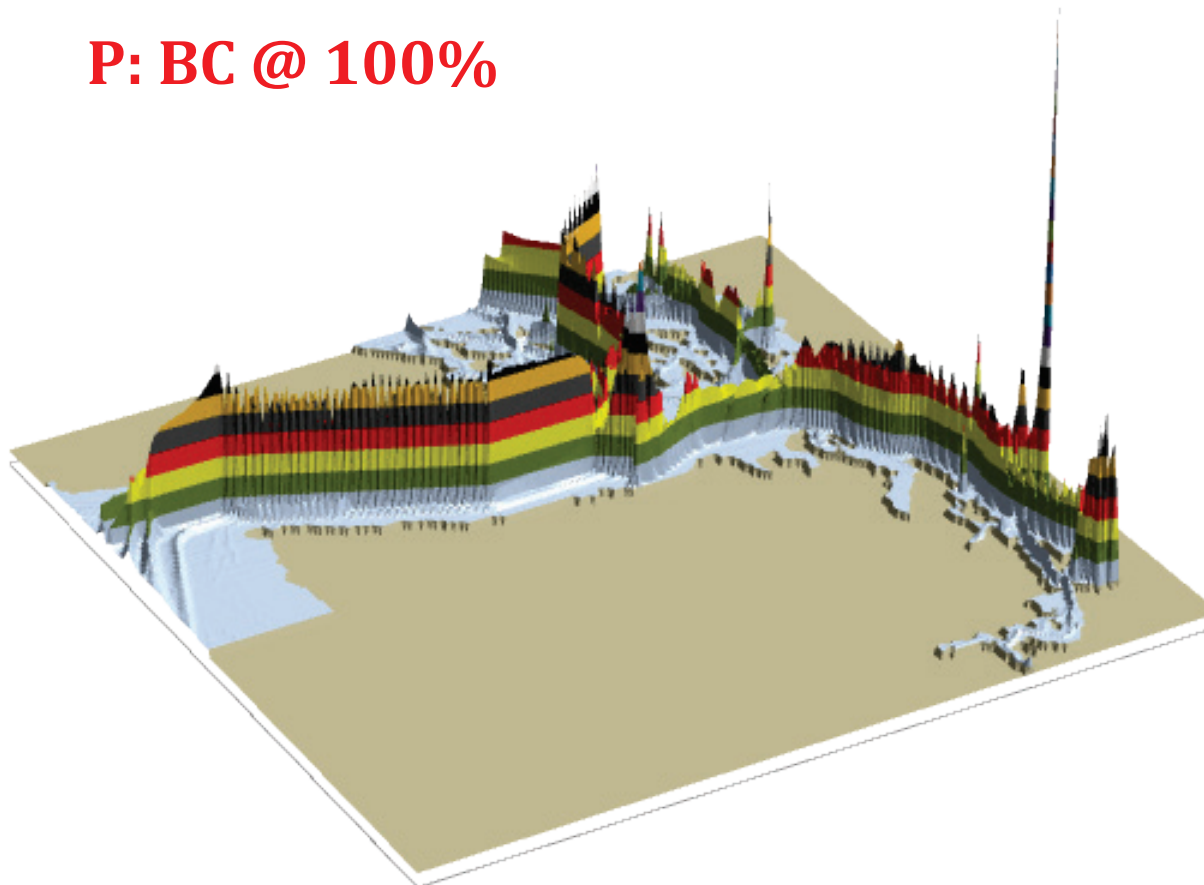
GWU Personnel: Dr. J. Rene van Dorp

VCU Personnel: Dr. Jason R. W. Merrick

VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2010

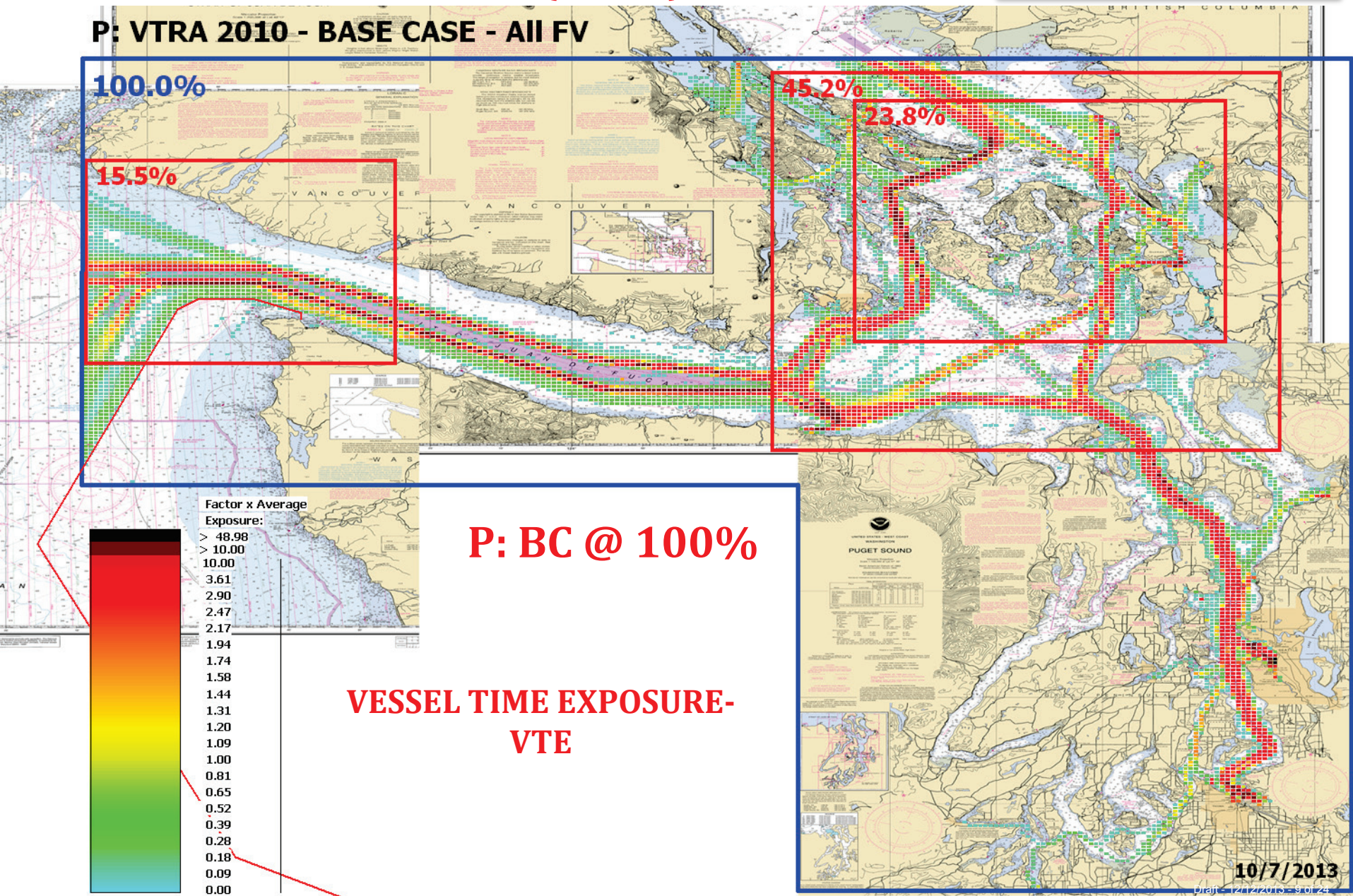
P: Base Case 3D Risk Profile All FV - Vessel Time Exposure: 100% of Base Case VTE

P: BC @ 100%



VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2010

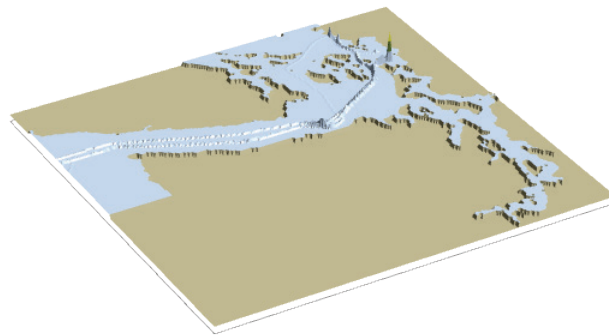
P: VTRA 2010 - BASE CASE - All FV



VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2010

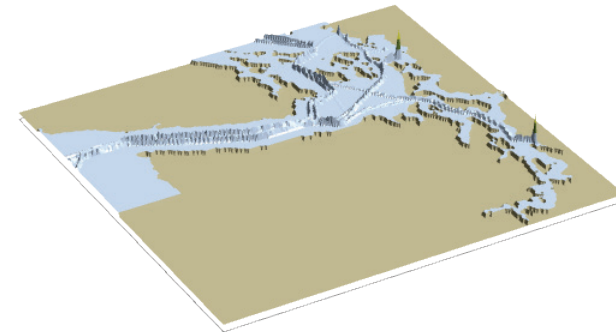
P: BC & HIGH TAN 3D Risk Profile
What-If FV - Vessel Time Exp.: 2% of Base Case VTE

**+2%
from P**



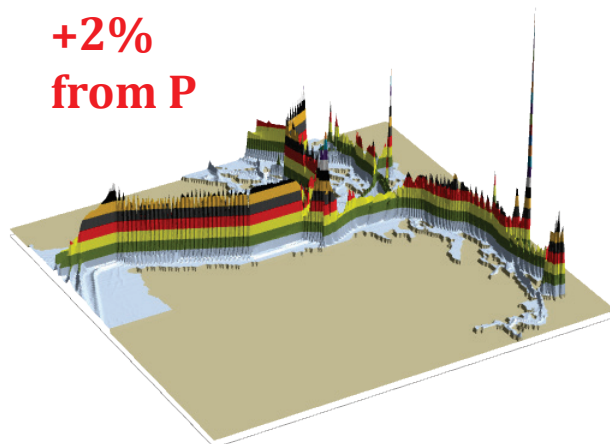
P: BC & HIGH TAN + CFV 3D Risk Profile
What-If FV - Vessel Time Exp.: 6% of Base Case VTE

**+6%
from P**



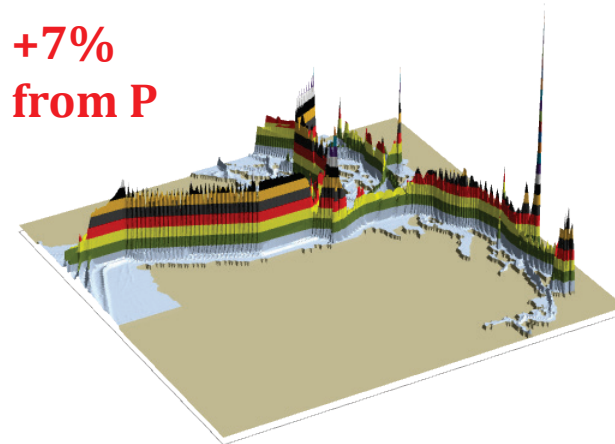
P: BC & HIGH TAN 3D Risk Profile
All FV - Vessel Time Exposure: 102% of Base Case VTE

**+2%
from P**



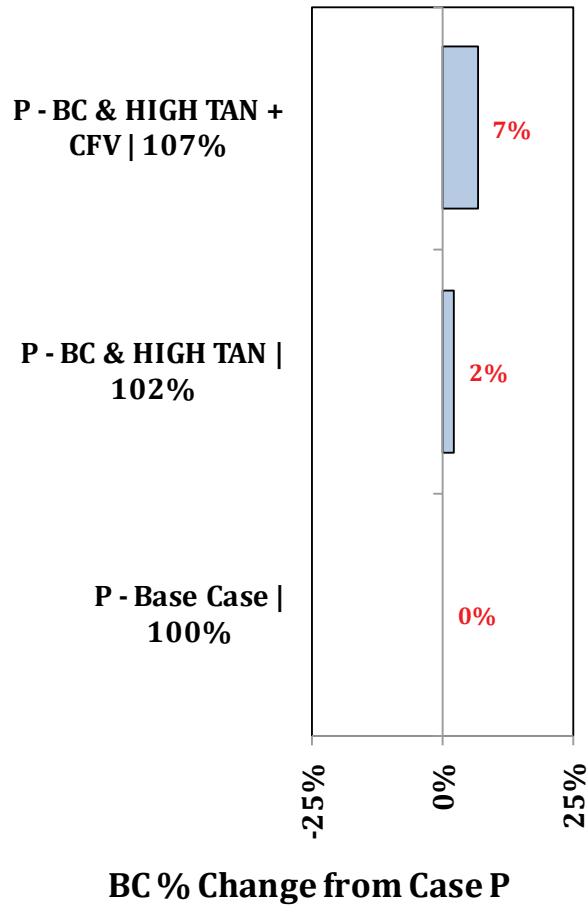
P: BC & HIGH TAN + CFV 3D Risk Profile
All FV - Vessel Time Exposure: 107% of Base Case VTE

**+7%
from P**



VTRA 2010 : VESSEL TIME EXPOSURE, POT. ACC. FREQ POT. OIL. LOSS COMPARISON ALL FOCUS VESSELS

**Annual Vessel Time
Exposure (WI + BC Vessels)**



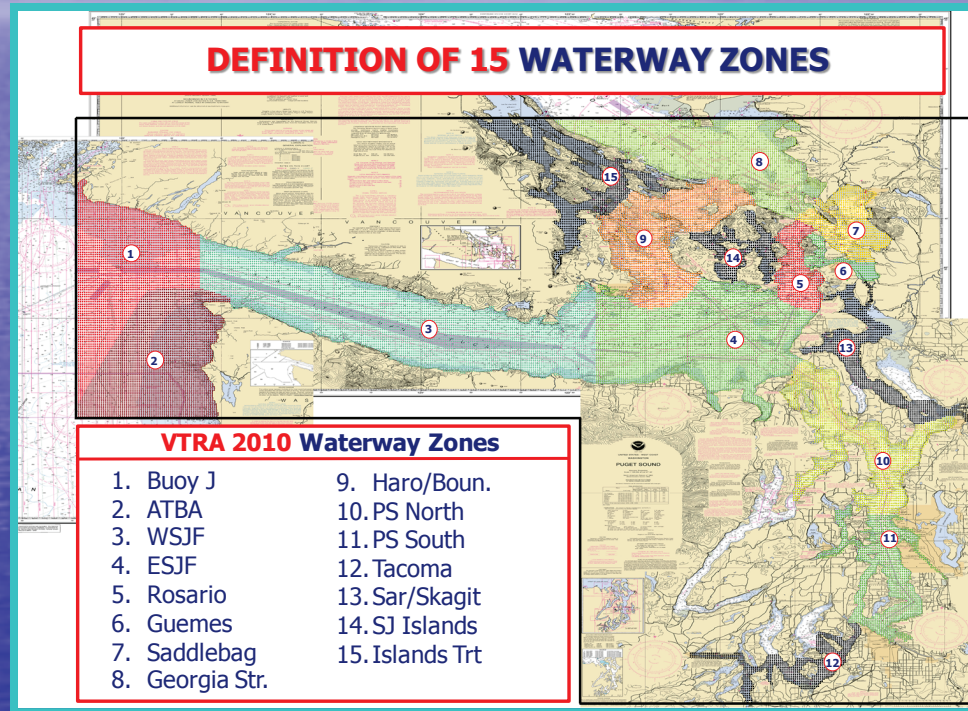
THE GEORGE
WASHINGTON
UNIVERSITY
WASHINGTON, DC

VCU

VTRA 2010 – SYNOPSIS OF 3D SCENARIO COMPARISON

POTENTIAL ACCIDENT FREQUENCY

By What-if Focus Vessels and Base Case Focus Vessels



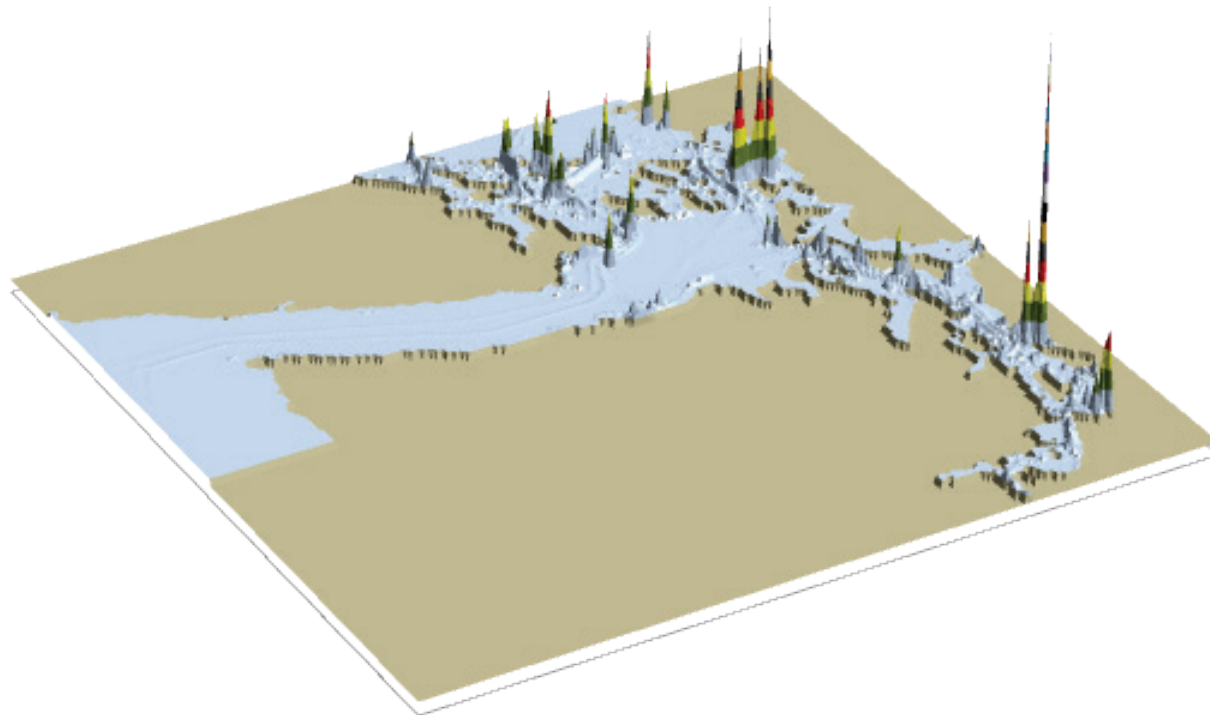
GWU Personnel: Dr. J. Rene van Dorp

VCU Personnel: Dr. Jason R. W. Merrick

VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2010

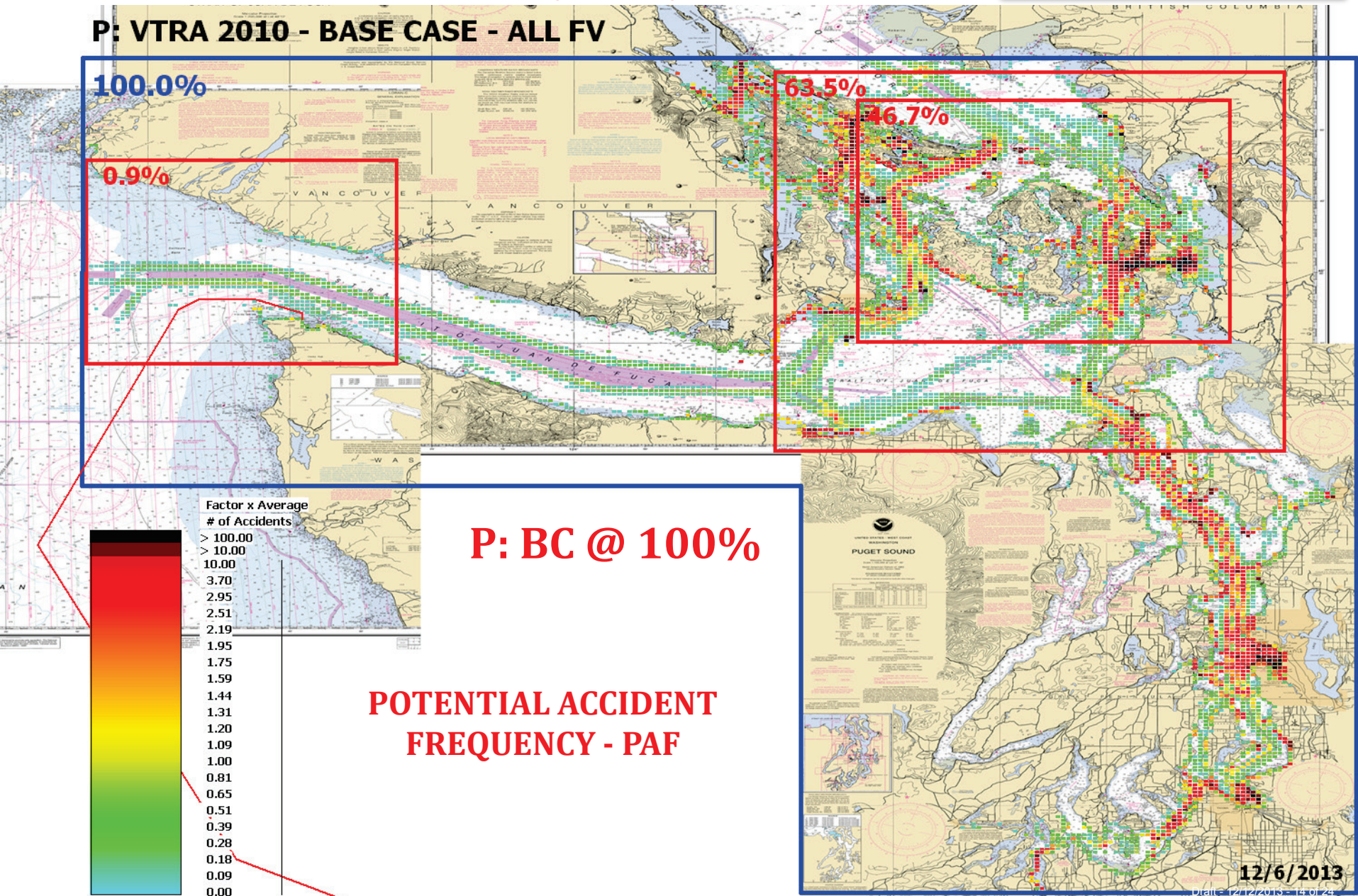
P: Base Case 3D Risk Profile All FV - Pot.Grou+Coll.Acc.Freq.: 100% of Base Case PCF

P: BC @ 100%



VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2010

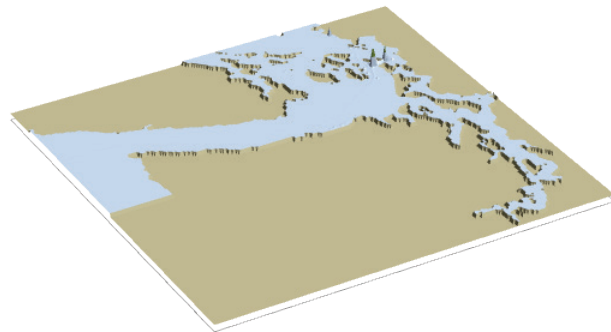
P: VTRA 2010 - BASE CASE - ALL FV



VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2010

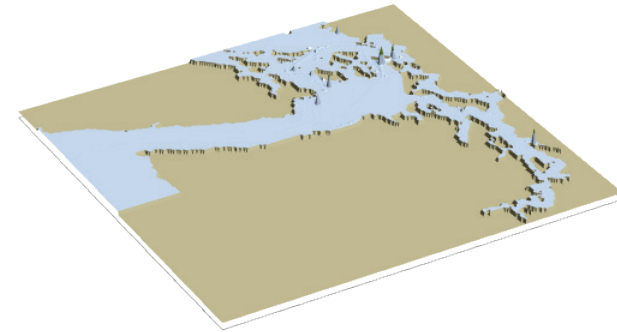
P: BC & HIGH TAN 3D Risk Profile
What If FV - Pot.Gr+Co.Acc.Freq.: 2% of Base Case PCF

**+2%
from P**



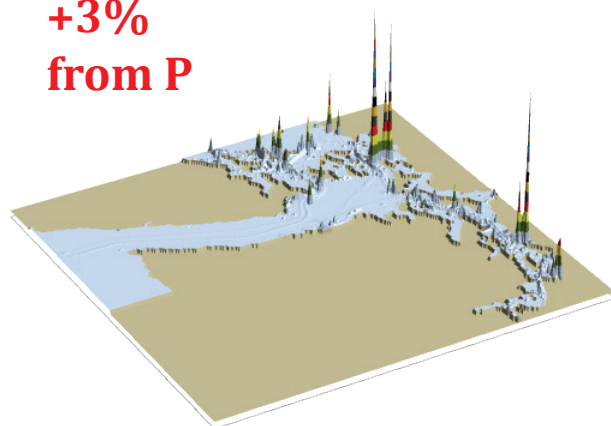
P: BC & HIGH TAN + CFV 3D Risk Profile
What If FV - Pot.Gr+Co.Acc.Freq.: 5% of Base Case PCF

**+5%
from P**



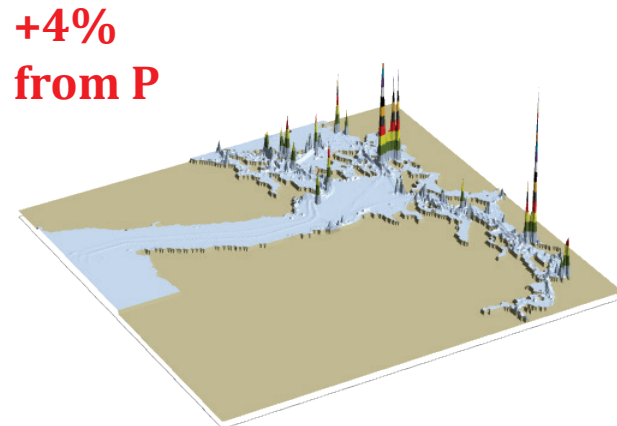
P: BC & HIGH TAN 3D Risk Profile
All FV - Pot.Grou+Coll.Acc.Freq.: 103% of Base Case PCF

**+3%
from P**



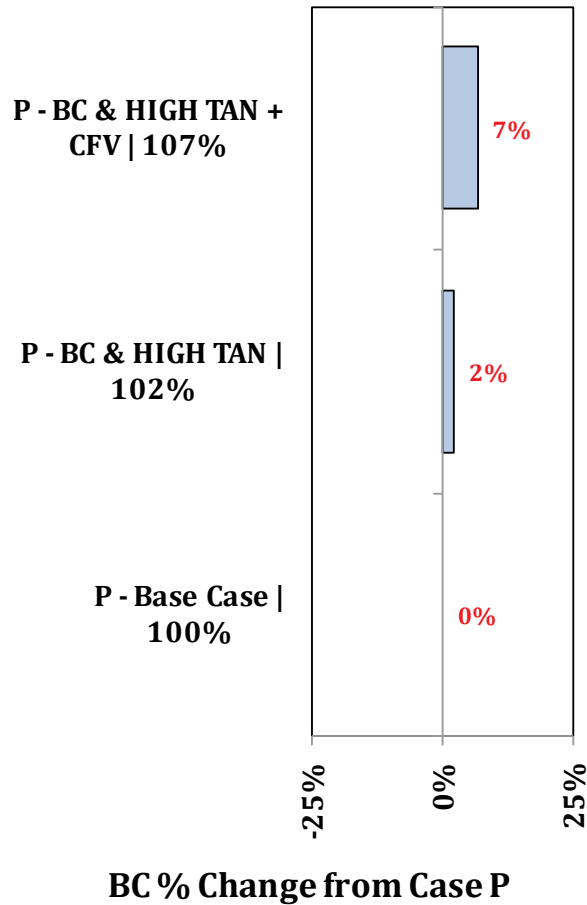
P: BC & HIGH TAN + CFV 3D Risk Profile
All FV - Pot.Grou+Coll.Acc.Freq.: 104% of Base Case PCF

**+4%
from P**

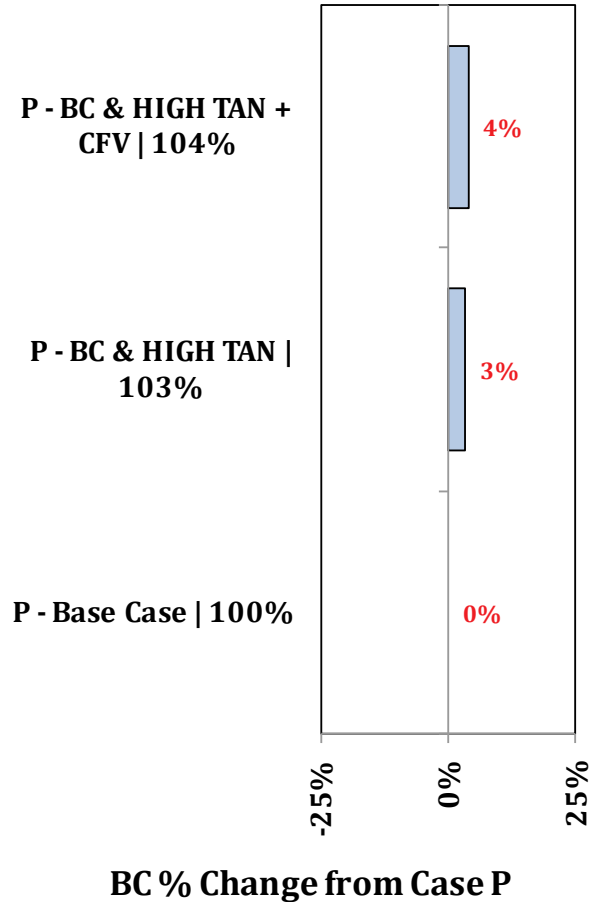


VTRA 2010 : VESSEL TIME EXPOSURE, POT. ACC. FREQ POT. OIL. LOSS COMPARISON ALL FOCUS VESSELS

**Annual Vessel Time
Exposure (WI + BC Vessels)**



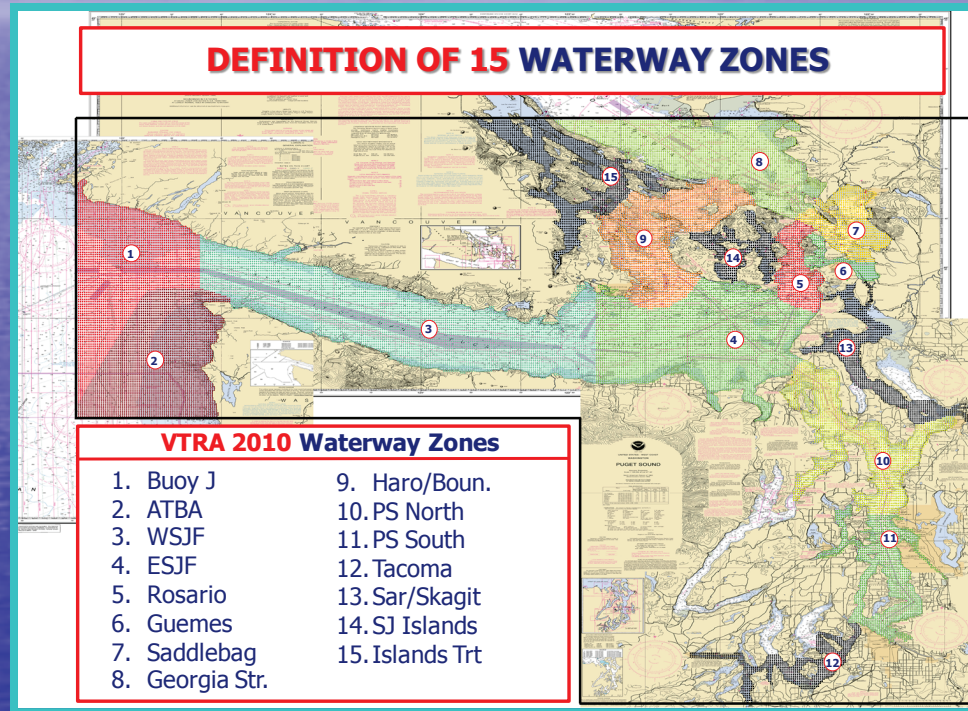
**Potential Accident (C+G)
Frequency (WI + BC Vessels)**



VTRA 2010 – SYNOPSIS OF 3D SCENARIO COMPARISON

POTENTIAL OIL LOSS

By What-if Focus Vessels and Base Case Focus Vessels



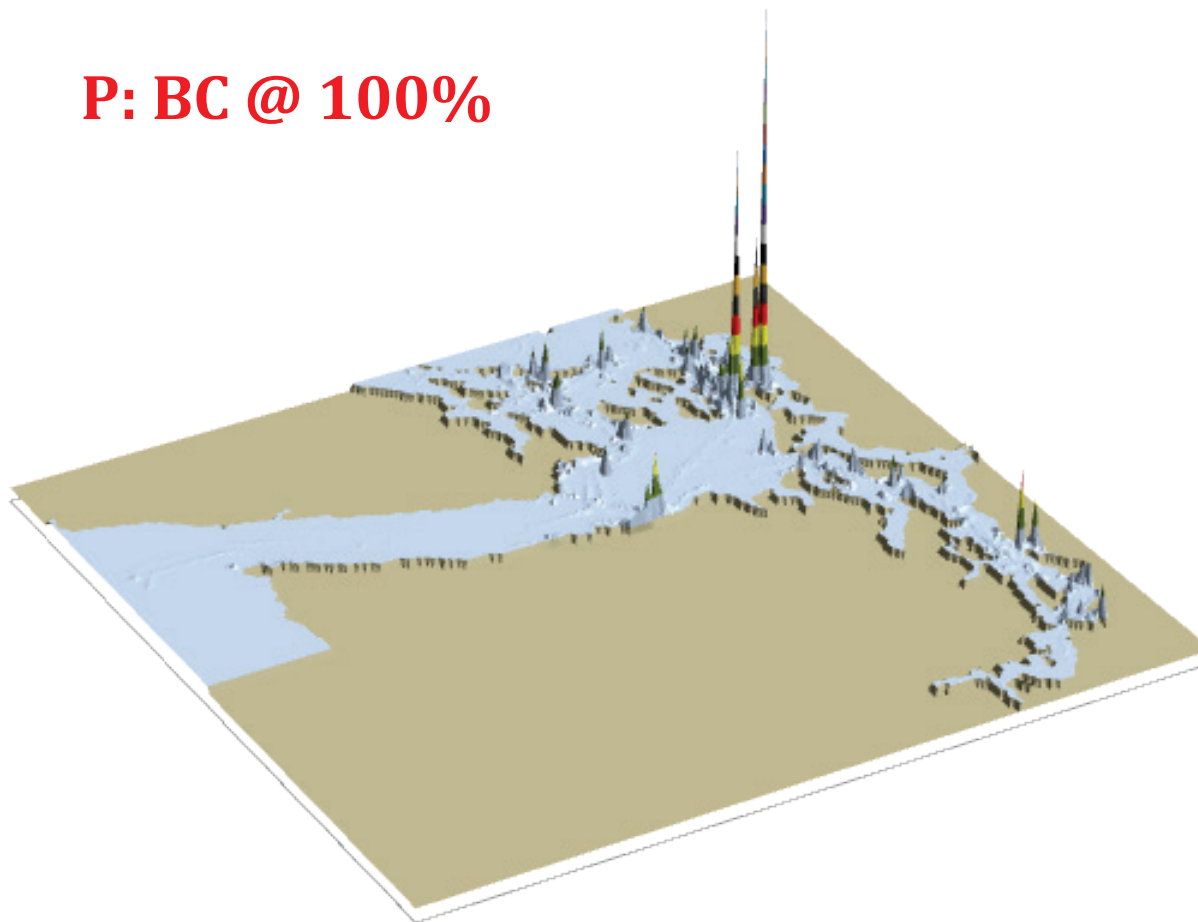
GWU Personnel: Dr. J. Rene van Dorp

VCU Personnel: Dr. Jason R. W. Merrick

VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2010

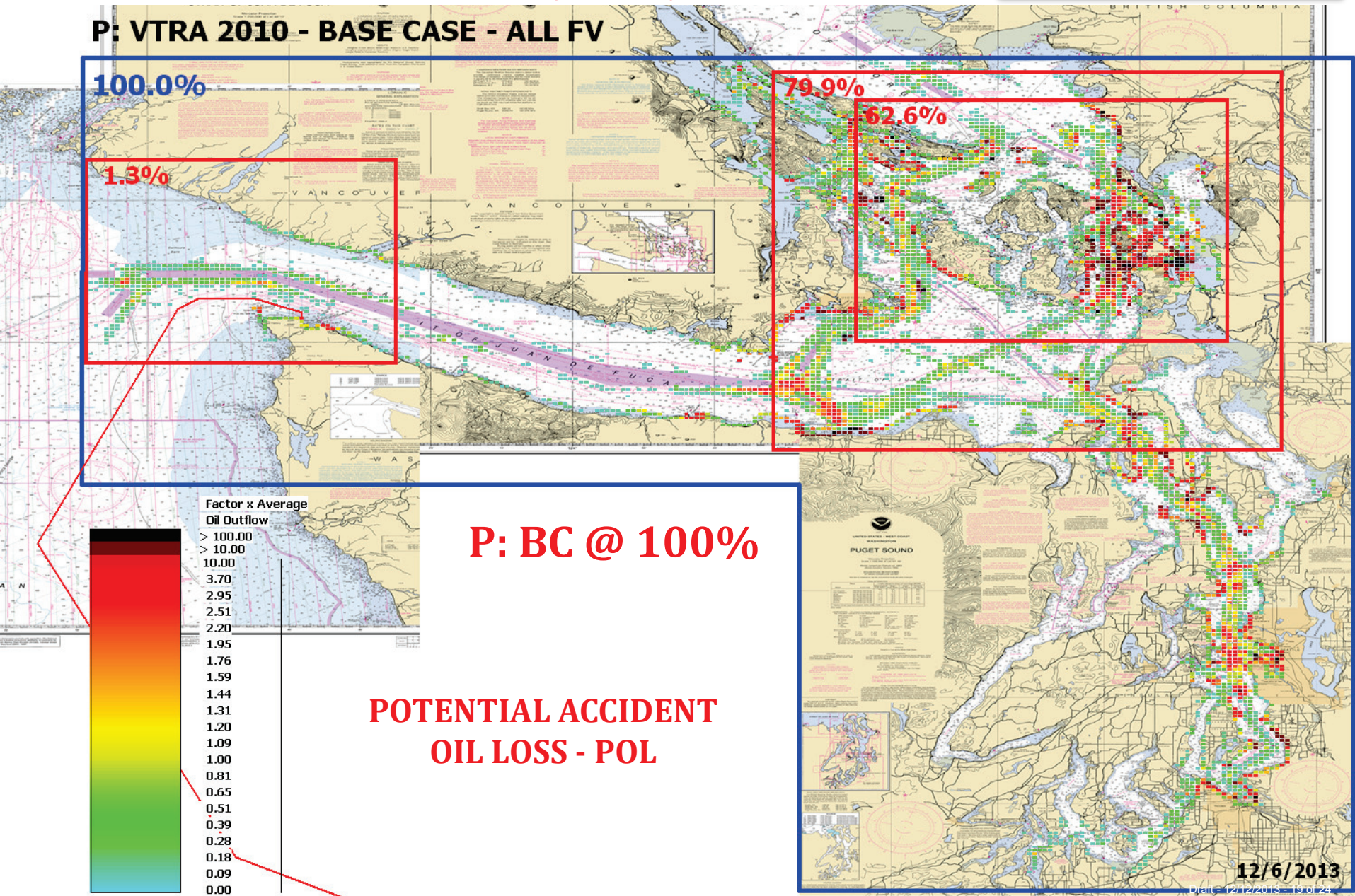
P: Base Case 3D Risk Profile All FV - Pot. Grou+Coll.Oil Loss: 100% of Base Case PCO

P: BC @ 100%



VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2010

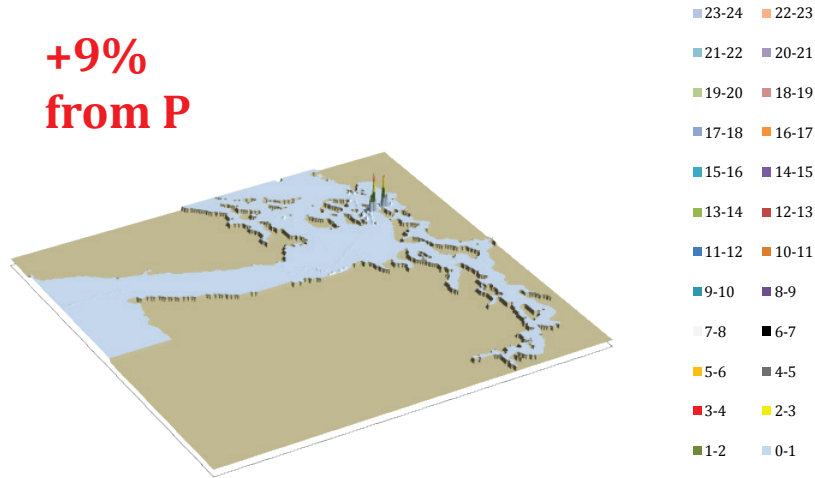
P: VTRA 2010 - BASE CASE - ALL FV



VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2010

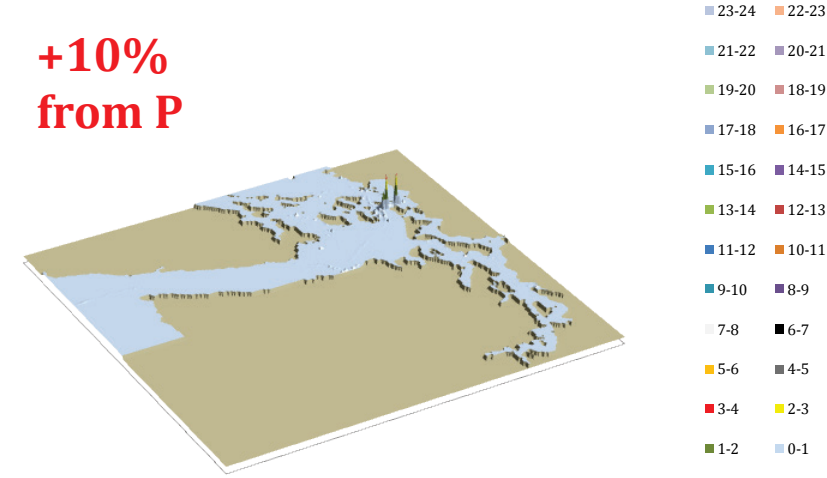
P: BC & HIGH TAN 3D Risk Profile
 What If FV - Pot. Gr+Co.Oil Loss: 9% of Base Case PCO

**+9%
from P**



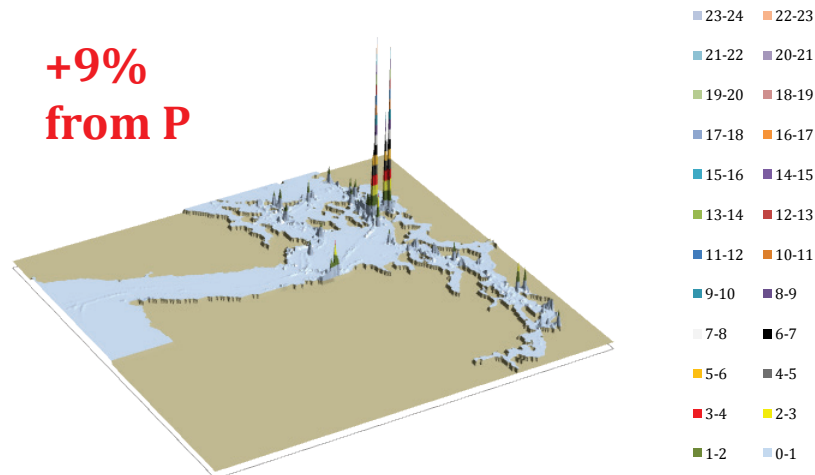
P: BC & HIGH TAN + CFV 3D Risk Profile
 What If FV - Pot. Gr+Co.Oil Loss: 10% of Base Case PCO

**+10%
from P**



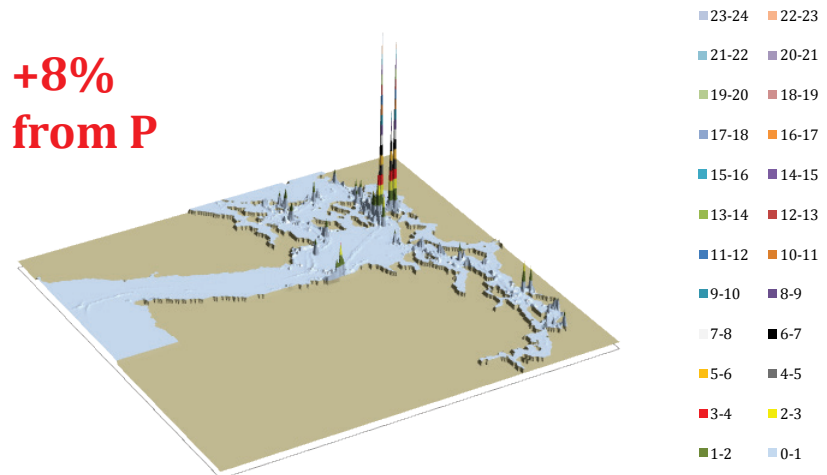
P: BC & HIGH TAN 3D Risk Profile
 All FV - Pot. Grou+Coll.Oil Loss: 109% of Base Case PCO

**+9%
from P**



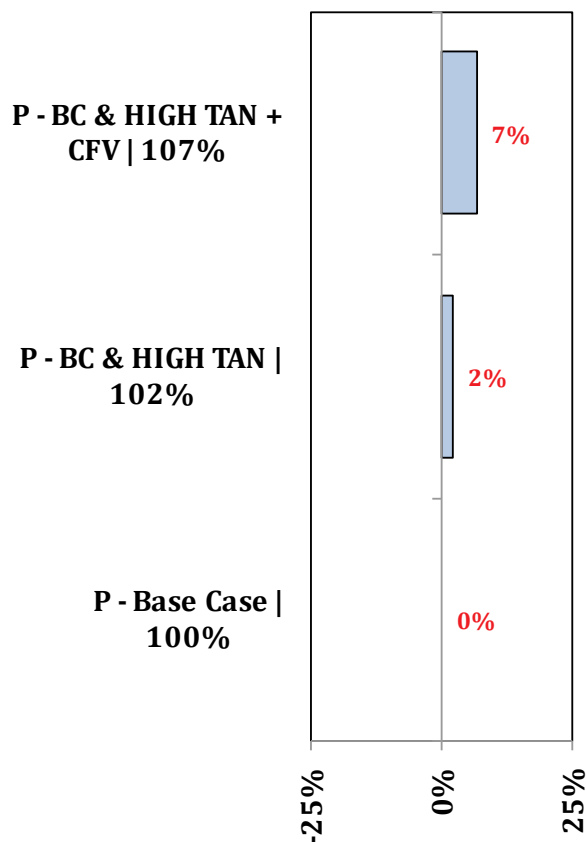
P: BC & HIGH TAN + CFV 3D Risk Profile
 All FV - Pot. Grou+Coll.Oil Loss: 108% of Base Case PCO

**+8%
from P**



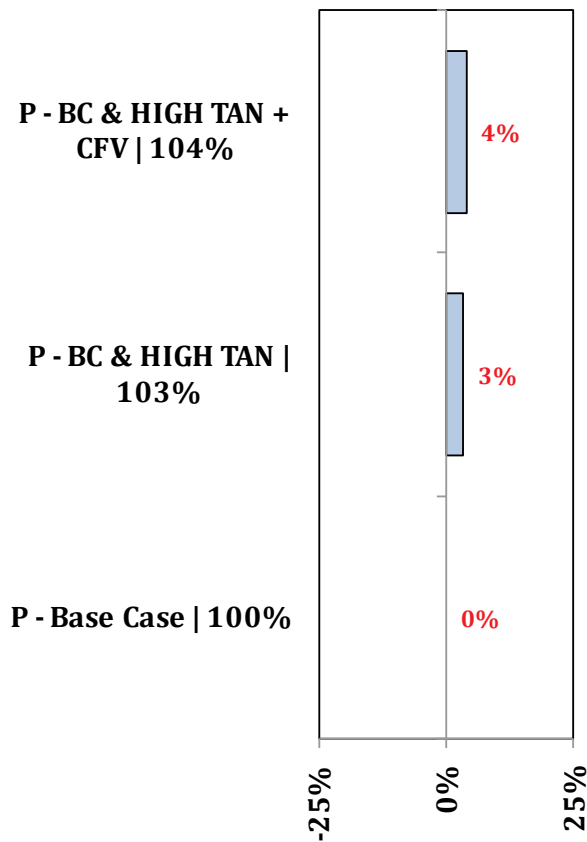
VTRA 2010 : VESSEL TIME EXPOSURE, POT. ACC. FREQ POT. OIL. LOSS COMPARISON ALL FOCUS VESSELS

**Annual Vessel Time
Exposure (WI + BC Vessels)**



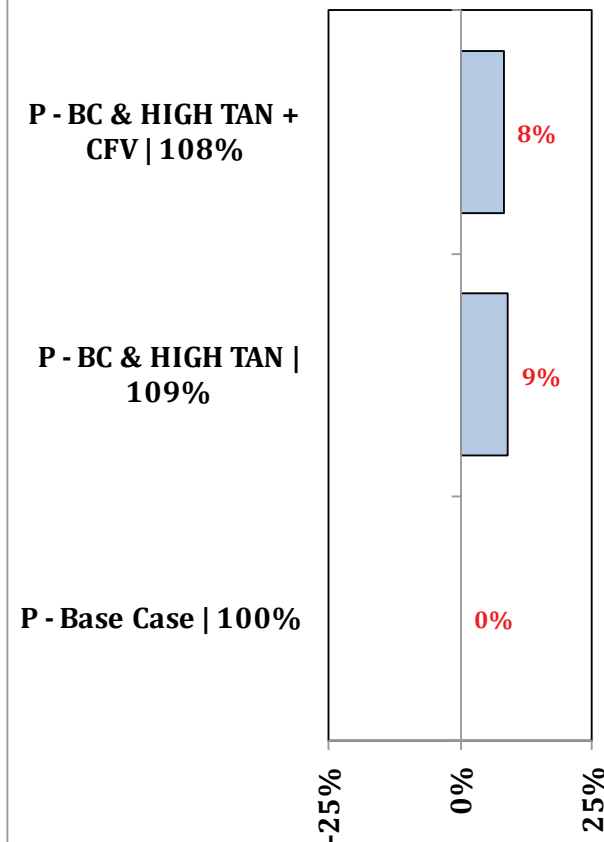
BC % Change from Case P

**Potential Accident (C+G)
Frequency (WI + BC Vessels)**



BC % Change from Case P

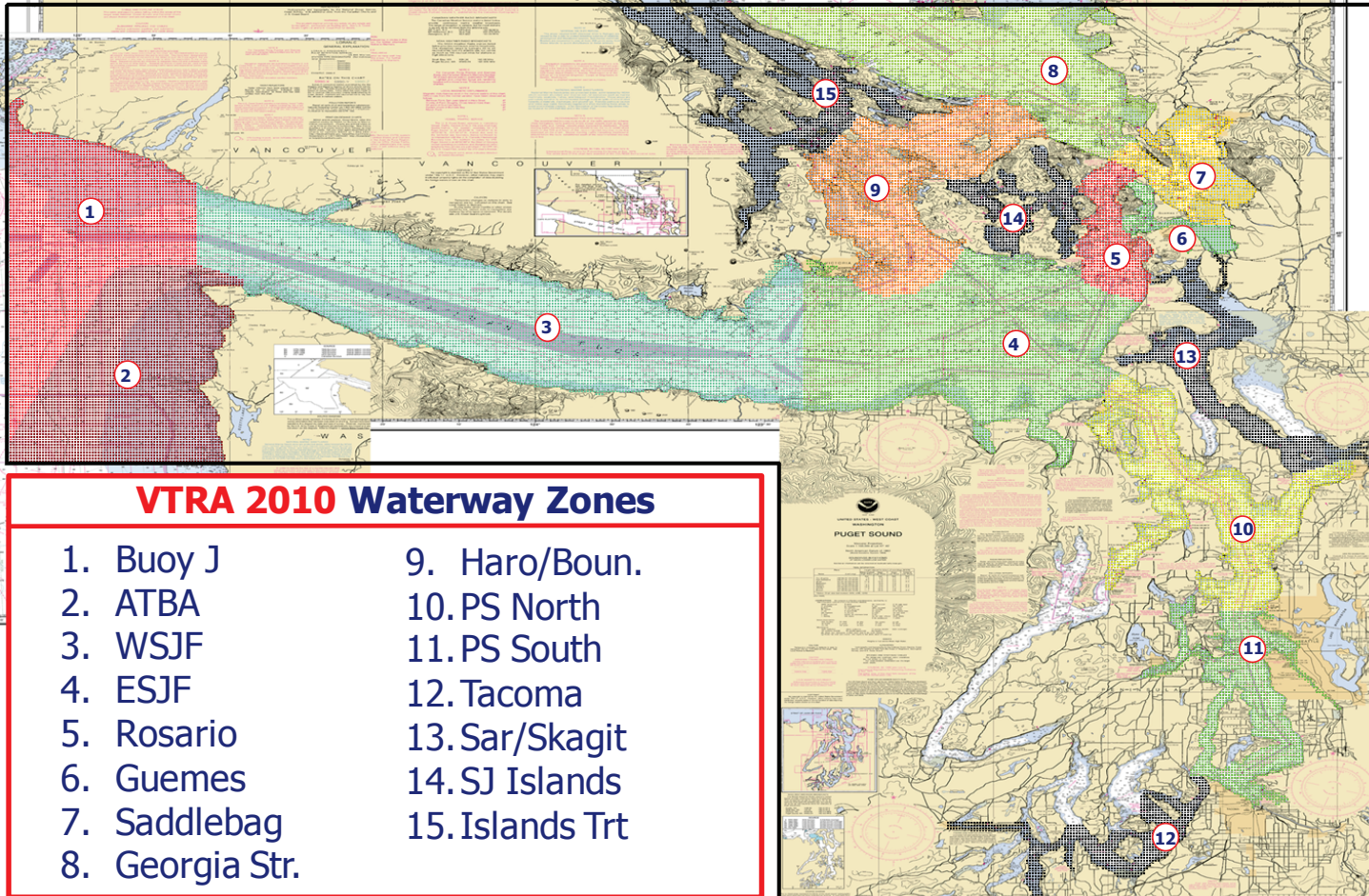
**Potential Acc. Oil (C + F) Loss
(WI + BC Vessels)**



BC % Change from Case P

VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2010

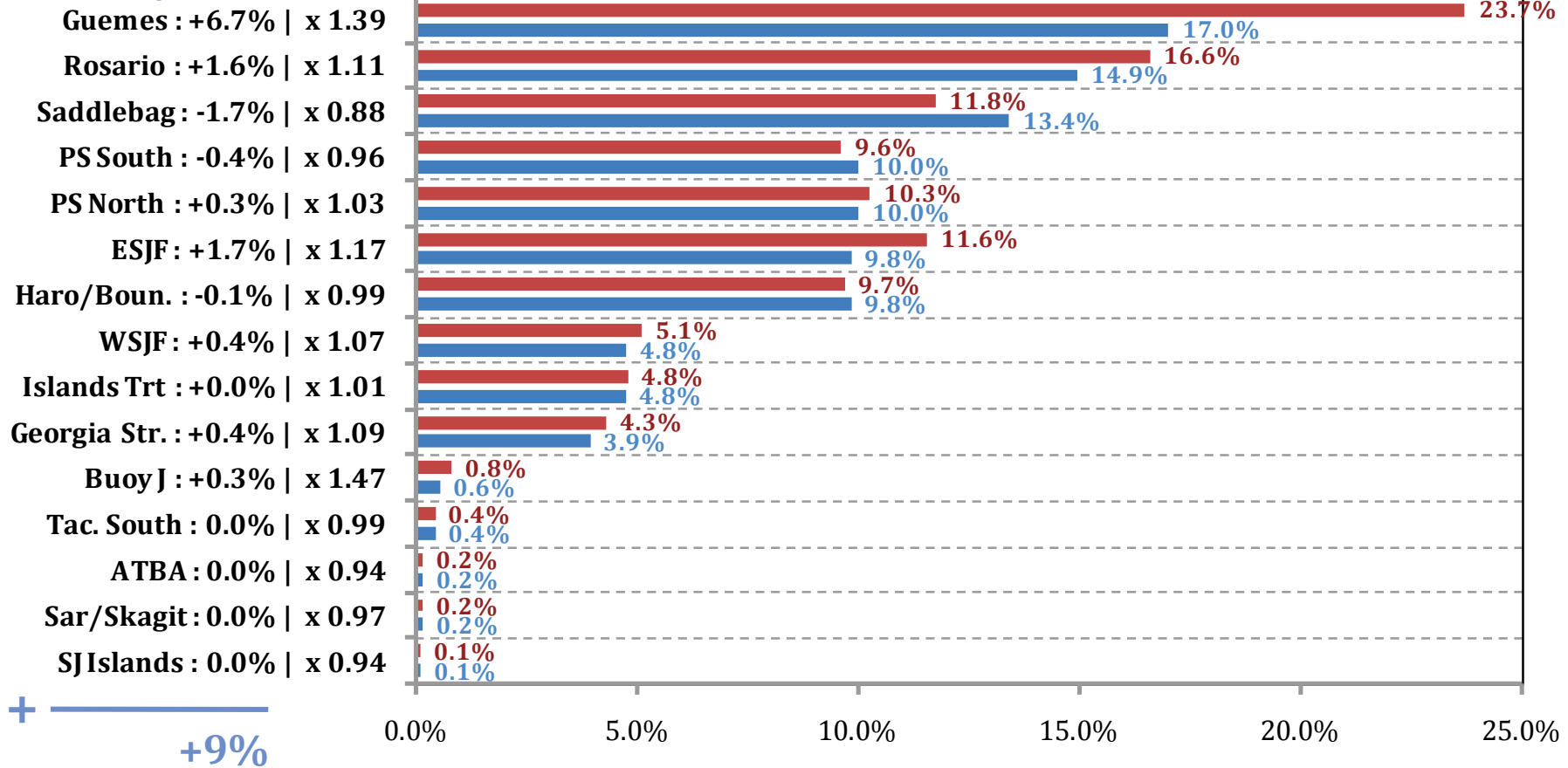
DEFINITION OF 15 WATERWAY ZONES



VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2010

% Base Case Oil (Coll. + Grou.) Loss - ALL_FV

Waterway Zone:



% Base Case Oil (Coll.+Grou.) Loss (OL) - ALL_FV

P & HT

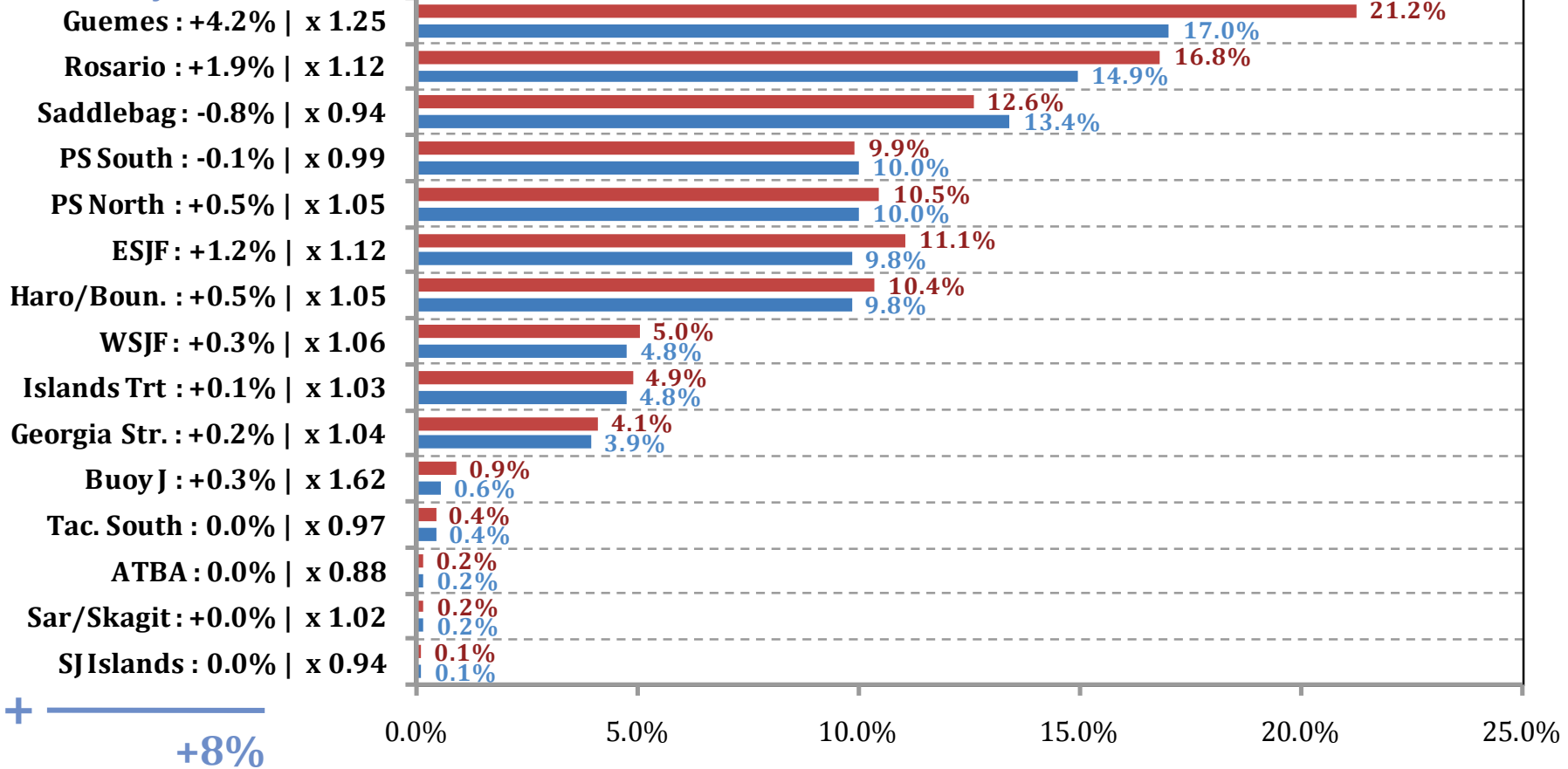
■ P: BC & HIGH TANKERS: 109% (+9.1% | x 1.09)

■ P: Base Case: 100%

VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2010

% Base Case Oil (Coll. + Grou.) Loss - ALL_FV

Waterway Zone:



% Base Case Oil (Coll.+Grou.) Loss (OL) - ALL_FV

P & HTC

■ P: BC & HIGH TAN-CARGO FV : 108% (+8.2% | x 1.08) ■ P: Base Case : 100%