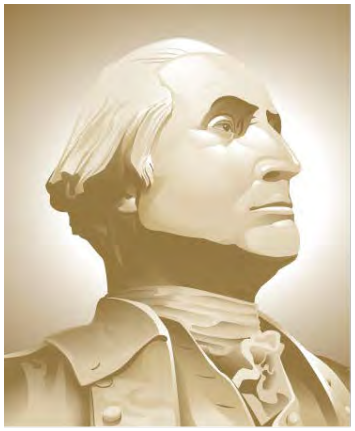
VTRA 2010 POTENTIAL GROUNDING FREQUENCY BY ALL FV, CARGO – FV, TANK- FV and WHAT-IF FV

Presentation by: J. Rene van Dorp



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CASE T: Gateway, Kinder Morgan, Delta Port

GWU Personnel: Dr. J. Rene van Dorp

VCU Personnel: Dr. Jason R. W. Merrick

OCTOBER 9, 2013

PRELIMINARY

Table. Focus Vessel (FV) Classification for the 26 VTOSS vessel type classification used in the GW/VCU MTS simulation model.

NON – FV : Those vessels that Interacting Vessels (IV) with Focus Vessels (FV)

BASE CASE CARGO – FV : Bulk Carriers, Container Vessels, Other Cargo Vessels that travel in VTRA 2010 Base Case

BASE CASE TANK – FV : Oil Barge, Oil Tankers, Chemical Carrier, ATB 's that travel in VTRA 2010 Base Case

WHAT IF – FV : CARGO AND TANK FV'S added to VTRA 2010 Base Case to model What-If Scenario

Note: Focus Vessels (FV's) are also considered as Interacting Vessels (IV's) when interacting with another Focus Vessel.

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#	VESSEL TYPE	FOCUS VESSEL?	#	VESSEL TYPE	FOCUS VESSEL?
1	BULKCARRIER	CARGO - FV	14	PASSENGERSHIP	NO
2	CHEMICALCARRIER	TANK - FV	15	REFRIGERATEDCARGO	CARGO-FV
3	CONTAINERSHIP	CARGO - FV	16	RESEARCHSHIP	NO
4	DECKSHIPCARGO	CARGO - FV	17	ROROCARGOSHIP	CARGO-FV
5	FERRY	NO	18	ROROCARGOCONTSHIP	CARGO-FV
6	FERRYNONLOCAL	NO	19	SUPPLYOFFSHORE	NO
7	FISHINGFACTORY	NO	20	TUGTOWBARGE	NO
8	FISHINGVESSEL	NO	21	UNKNOWN	NO
9	LIQGASCARRIER	TANK - FV	22	USCOASTGUARD	NO
10	NAVYVESSEL	NO	23	VEHICLECARRIER	CARGO-FV
11	OILTANKER	TANK - FV	24	YACHT	NO
12	OTHERSPECIALCARGO	CARGO - FV	25	ATB	TANK - FV
13	OTHERSPECIFICSERV	NO	26	OIL BARGE	TANK - FV

IMPORTANT:

THE OPERATIVE WORD IN PRESENTING THESE ANALYSIS RESULTS IS THE USE OF THE WORD

POTENTIAL

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TO INDICATE THAT THESE ANALYSIS RESULTS DO NOT FOLLOW FROM AN HISTORICAL DATA ANALYSIS, BUT THROUGH THE USE OF AN ANALYSIS TOOL THAT EVALUATES SUCH **POTENTIAL**.

THE 2010 YEAR IS CONSIDERED **THE BASE CASE YEAR** AND A BASE CASE YEAR POTENTIAL IS EVALUATED.

NEXT, **WHAT-IF SCENARIOS** ARE DEVELOPED FROM THE BASE CASE BY ADDING ADDITIONAL HYPOTHETICAL TRAFFIC AND A WHAT-IF POTENTIAL IS EVALUATED AND COMPARED **RELATIVE TO THE BASE CASE** TO INFORM **RISK MANAGEMENT.**

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BASE CASE 2010 TRAFFIC WITH FOLLOWING WHAT-IF FOCUS VESSELS

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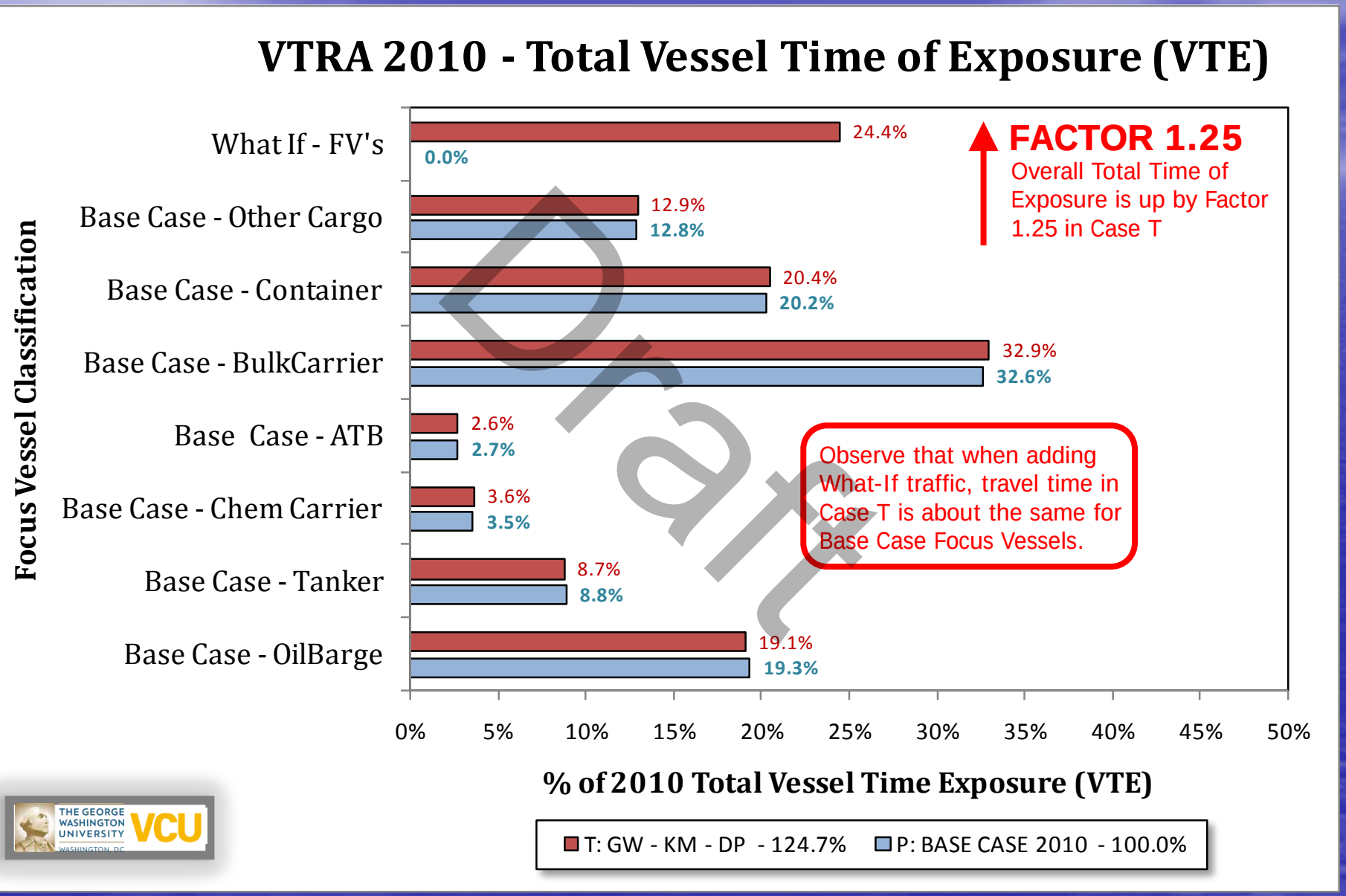
487 Gateway Bulk Carriers + Bunkering Barges

348 Kinder Morgan Tankers + Bunkering Barges

348 Delta Port Bulk Carriers + Bunkering Barges

67 Delta Port Container Ships+ Bunkering Barges

CASE T: GW 487, KM 348, DP 348 and 67:



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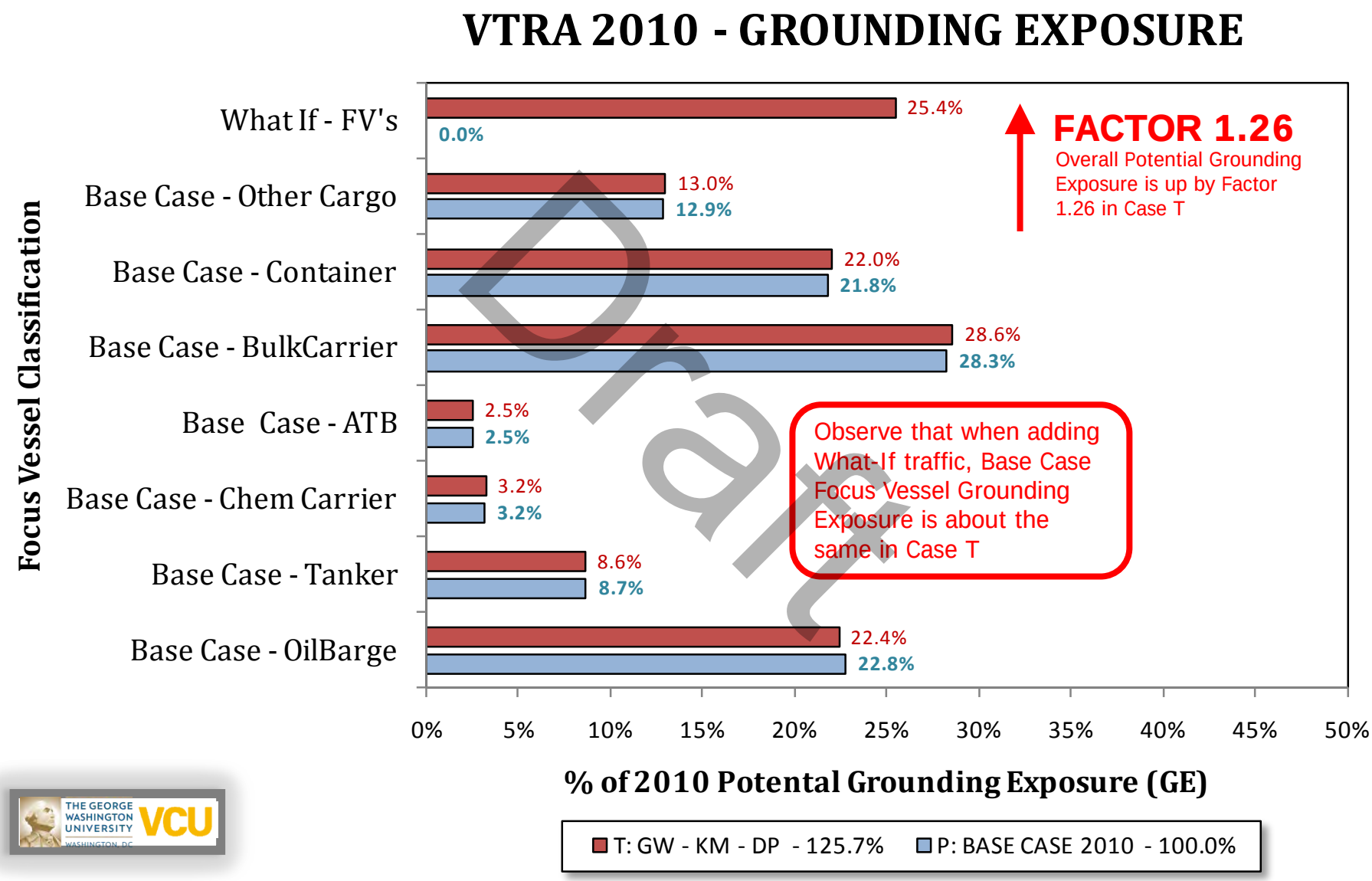

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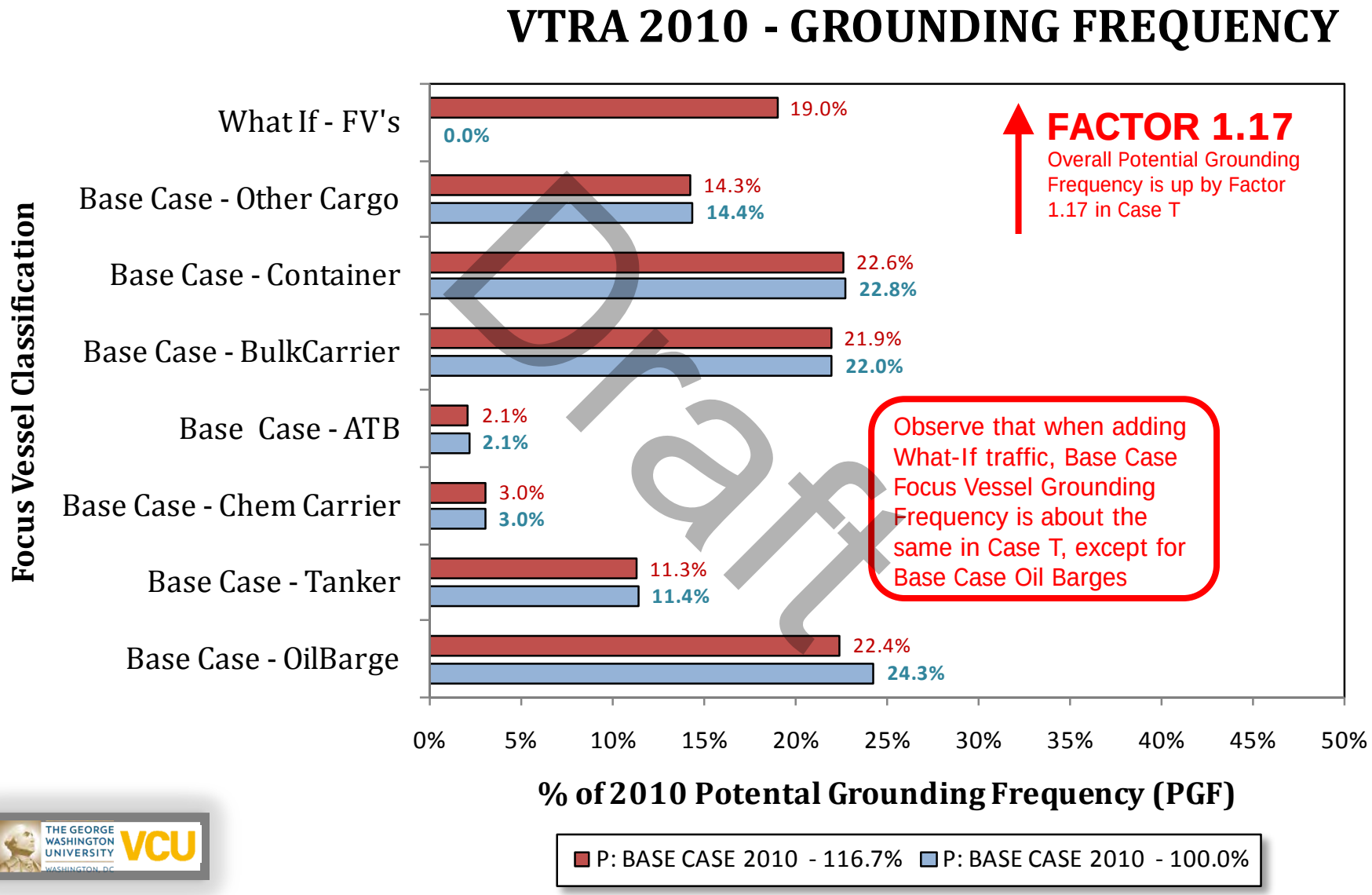

A TAXONOMY OF 2010 FOCUS VESSEL POTENTIAL ANNUAL GROUNDING FREQUENCY

PCF : POTENTIAL GROUNDING FREQUENCY - PER YEAR

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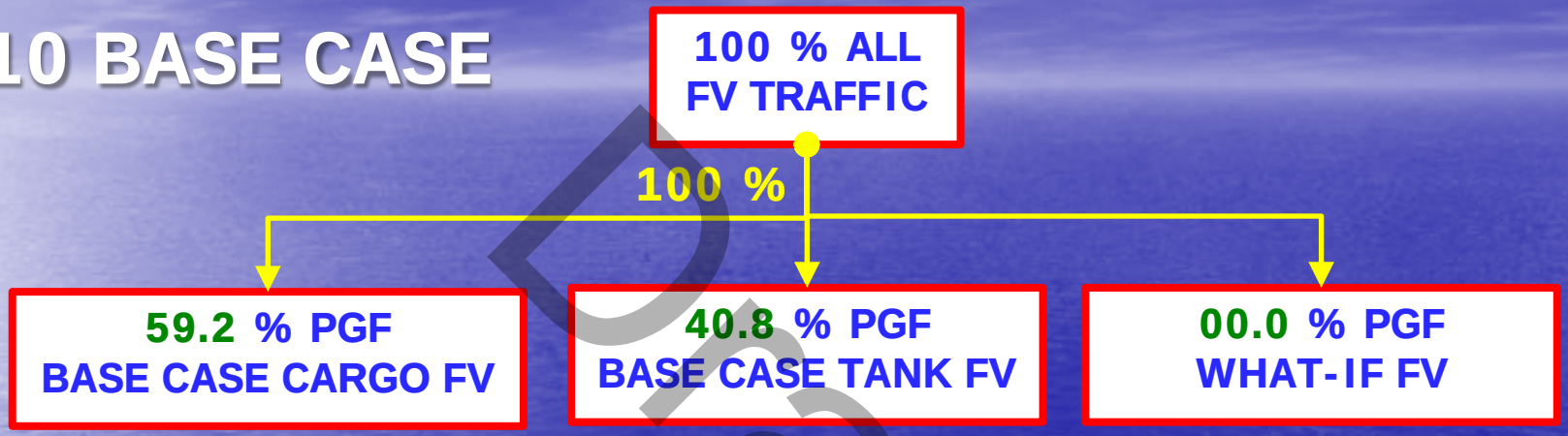
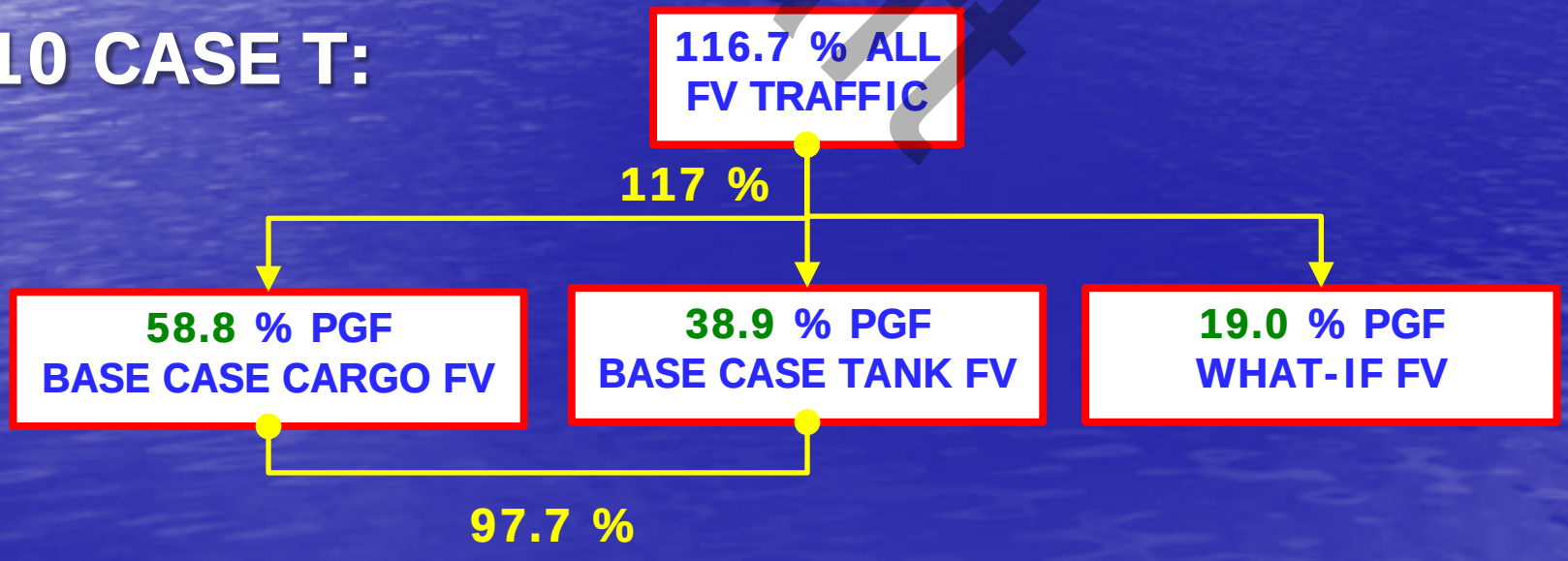
2010 BASE CASE

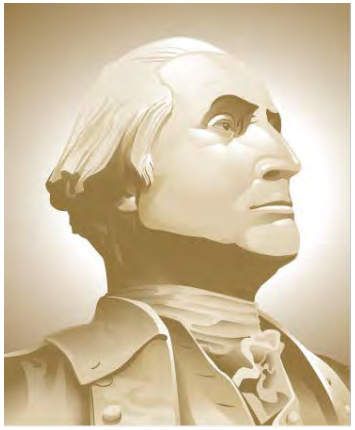


2010 CASE T:



VTRA 2010 GROUNDING FREQ. BY CARGO – FV and TANK- FV A WATERWAY BY LOCATION ANALYSIS

Presentation by: J. Rene van Dorp



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CASE T: Gateway, Kinder Morgan, Delta Port

GWU Personnel: Dr. J. Rene van Dorp

VCU Personnel: Dr. Jason R. W. Merrick

OCTOBER 9, 2013

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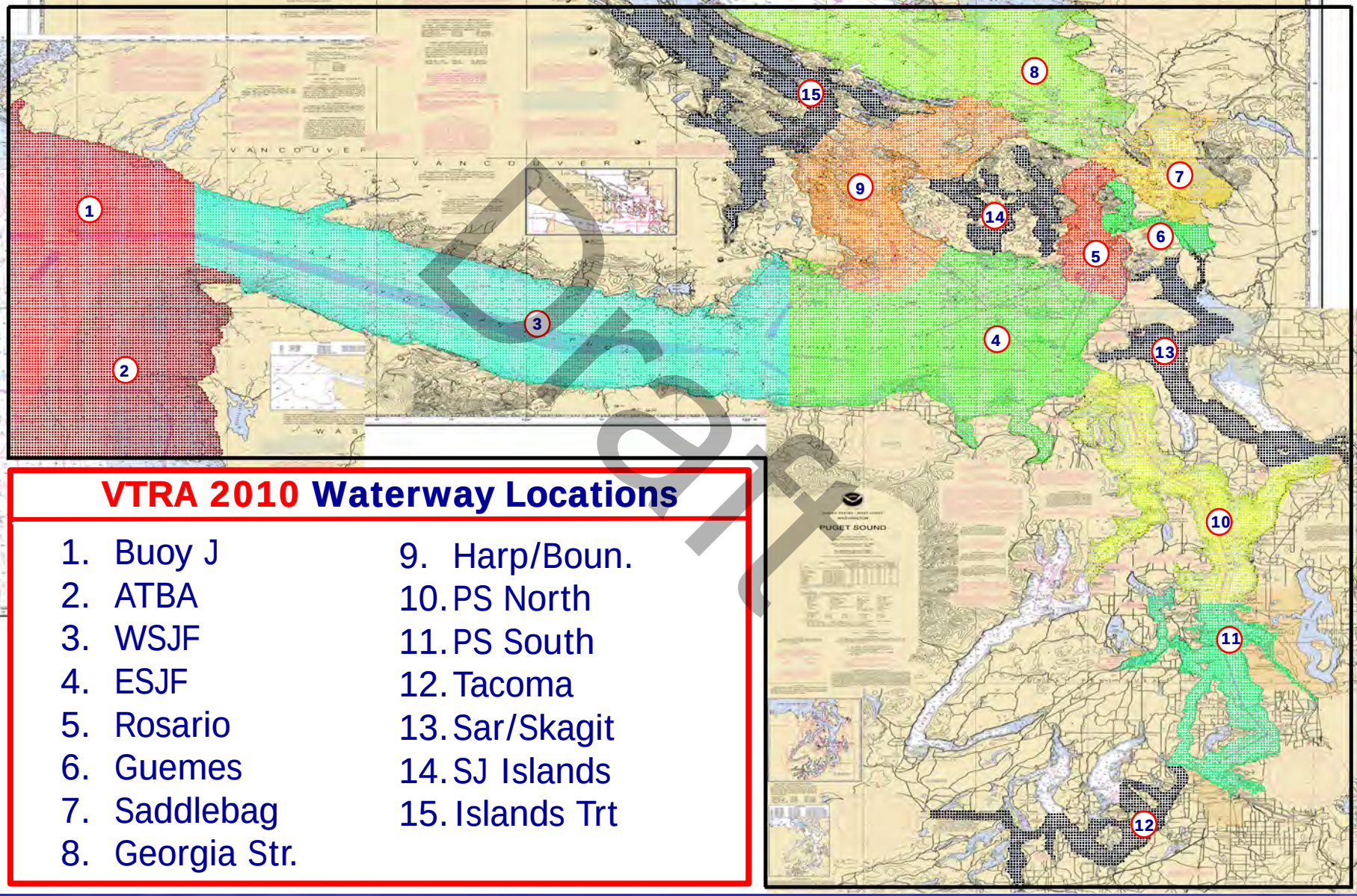
DEFINITION OF 15 WATERWAY LOCATIONS



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VTRA 2010 Waterway Locations

1. Buoy J
2. ATBA
3. WSJF
4. ESJF
5. Rosario
6. Guemes
7. Saddlebag
8. Georgia Str.
9. Harp/Boun.
10. PS North
11. PS South
12. Tacoma
13. Sar/Skagit
14. SJ Islands
15. Islands Trt

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P: ALL FV POTENTIAL GROUNDING FREQUENCY (PGF)

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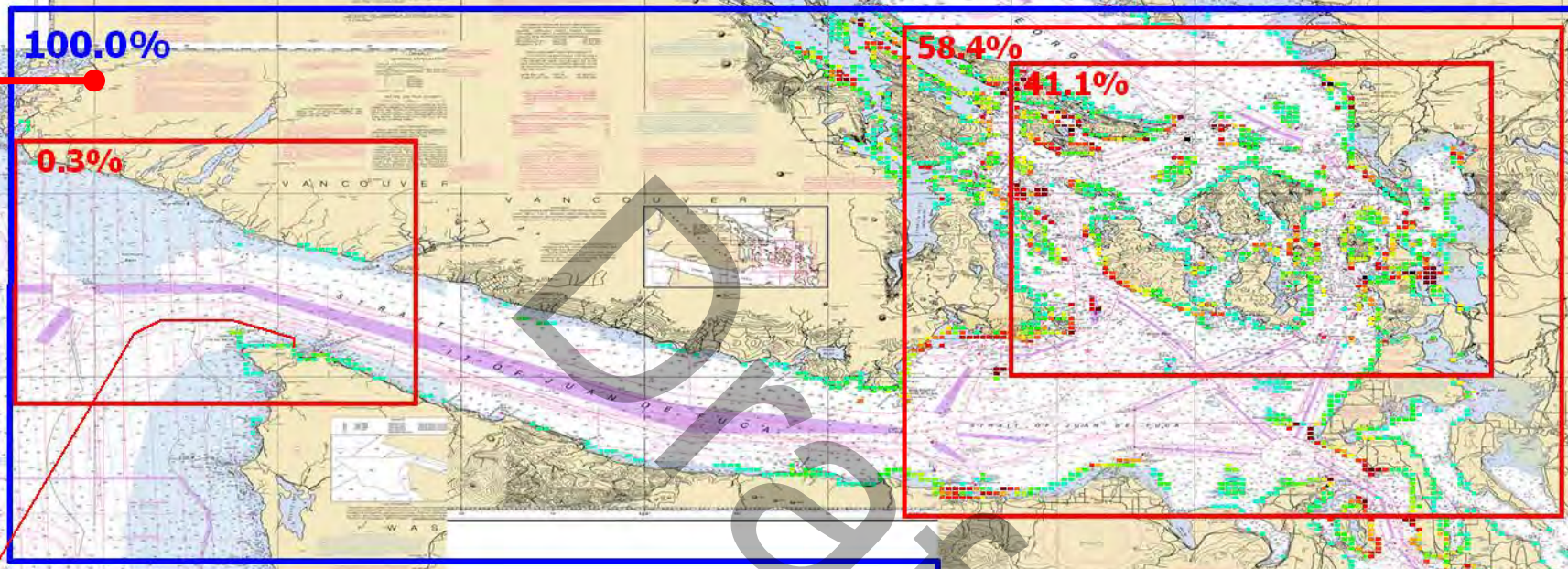
P: VTRA 2010 - BASE CASE



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Factor x Average # of Accidents

> 100.00
> 10.00
10.00
3.68
2.94
2.50
2.19
1.95
1.75
1.59
1.44
1.31
1.20
1.09
1.00
0.81
0.65
0.51
0.28
0.18
0.09
0.00

P: POTENTIAL GROUND. FREQ. (PGF)

22.0% - BULK CARGO
22.8% - CONTAINERSHIP
14.4% - OTHERCARGO
24.3% - OIL BARGE
11.4% - TANKER
03.0% - CHEMICAL CARRIER
02.1% - ATB
00.0% - WHAT-IF FV

\+

100.0% of 2010 Base Case
ALL FV - PGF

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T: ALL FV POTENTIAL GROUNDING FREQUENCY (PGF)

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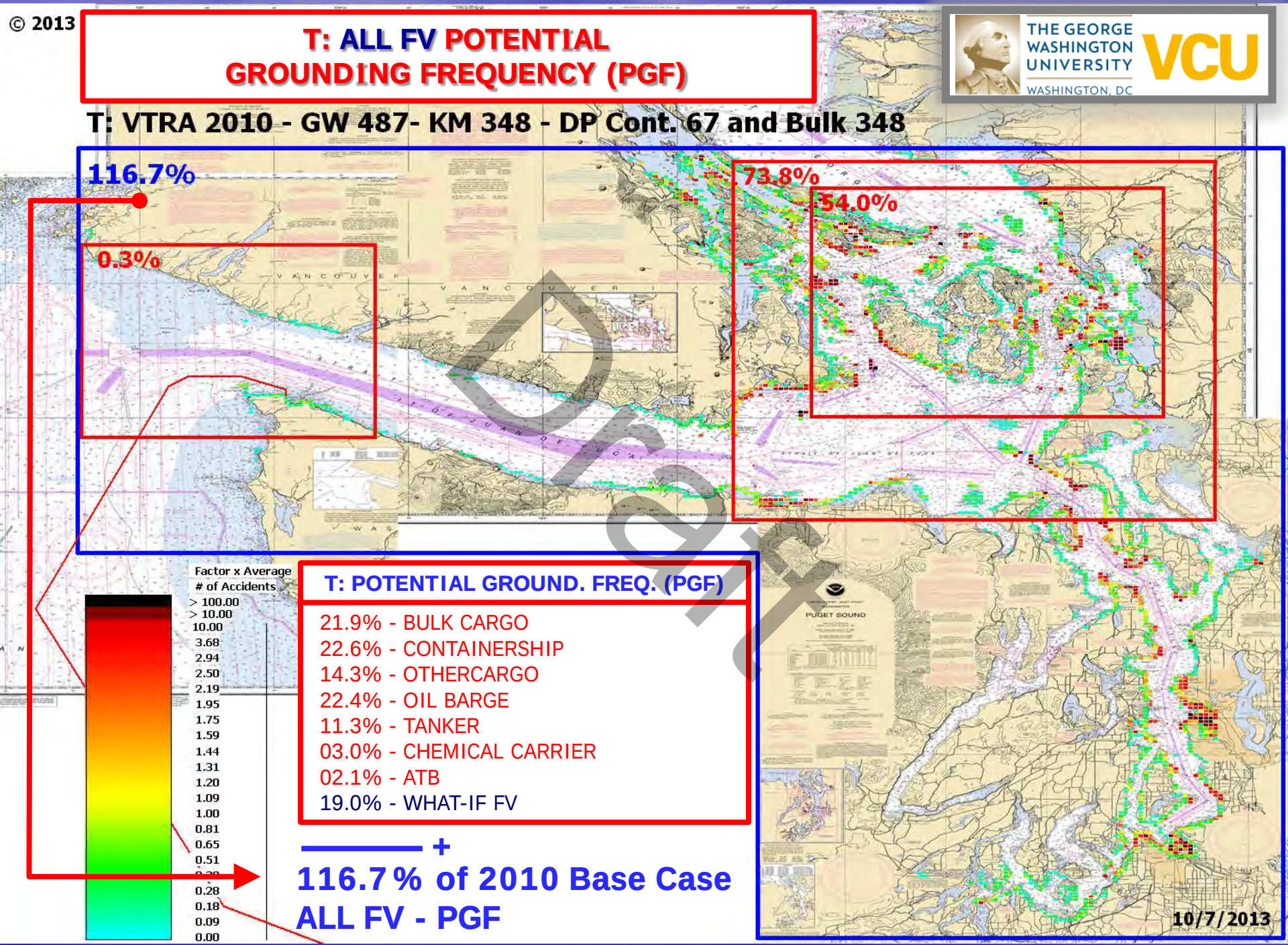
T: VTRA 2010 - GW 487- KM 348 - DP Cont. 67 and Bulk 348



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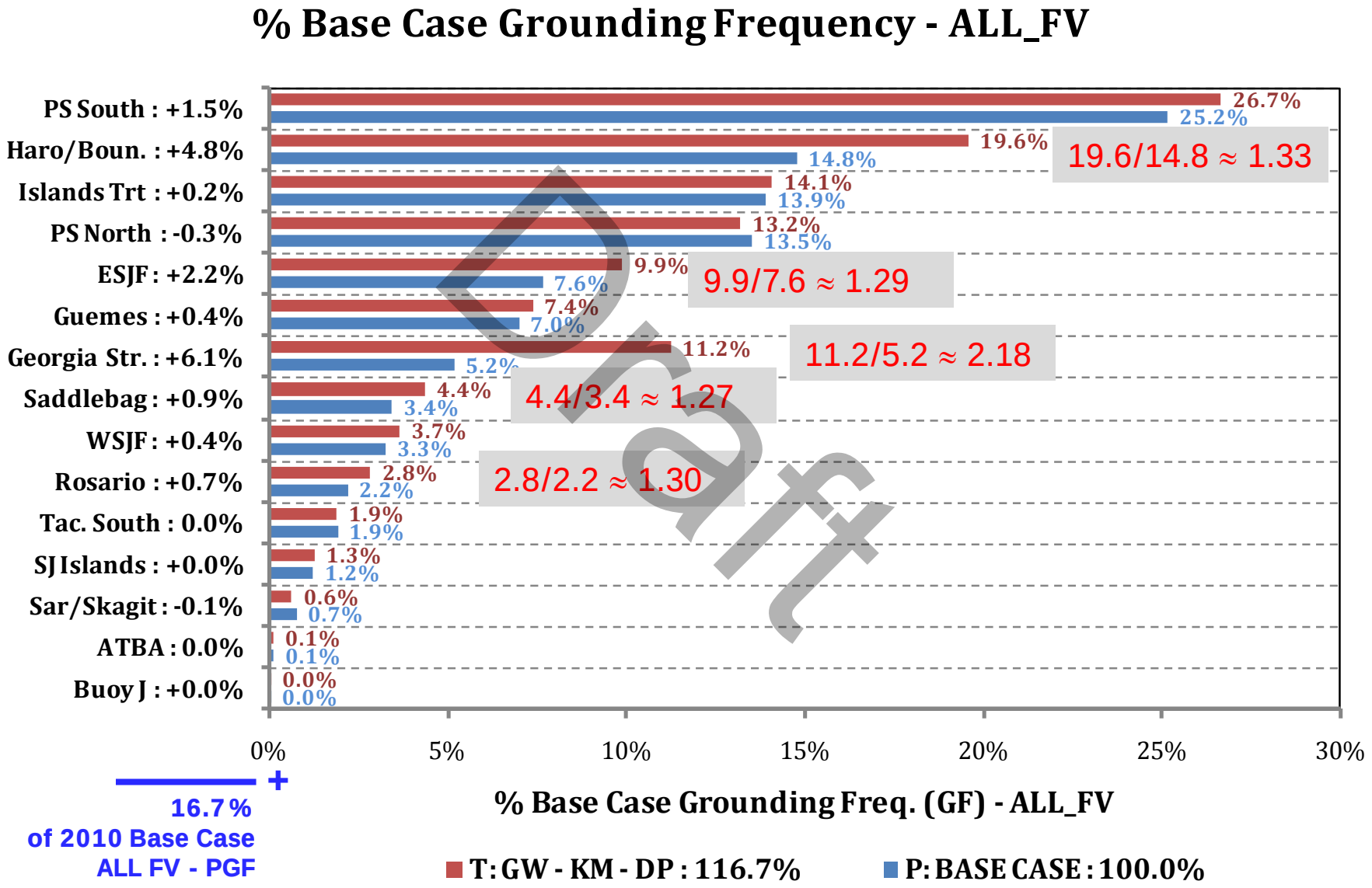
T: POTENTIAL GROUND. FREQ. (PGF)

21.9% - BULK CARGO
22.6% - CONTAINERSHIP
14.3% - OTHERCARGO
22.4% - OIL BARGE
11.3% - TANKER
03.0% - CHEMICAL CARRIER
02.1% - ATB
19.0% - WHAT-IF FV

\+

116.7% of 2010 Base Case ALL FV - PGF

WATERWAY LOCATION
Potential Grounding Freq. Comparison – ALL FV



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T: WHAT-IF FV POTENTIAL GROUNDING FREQUENCY (PGF)

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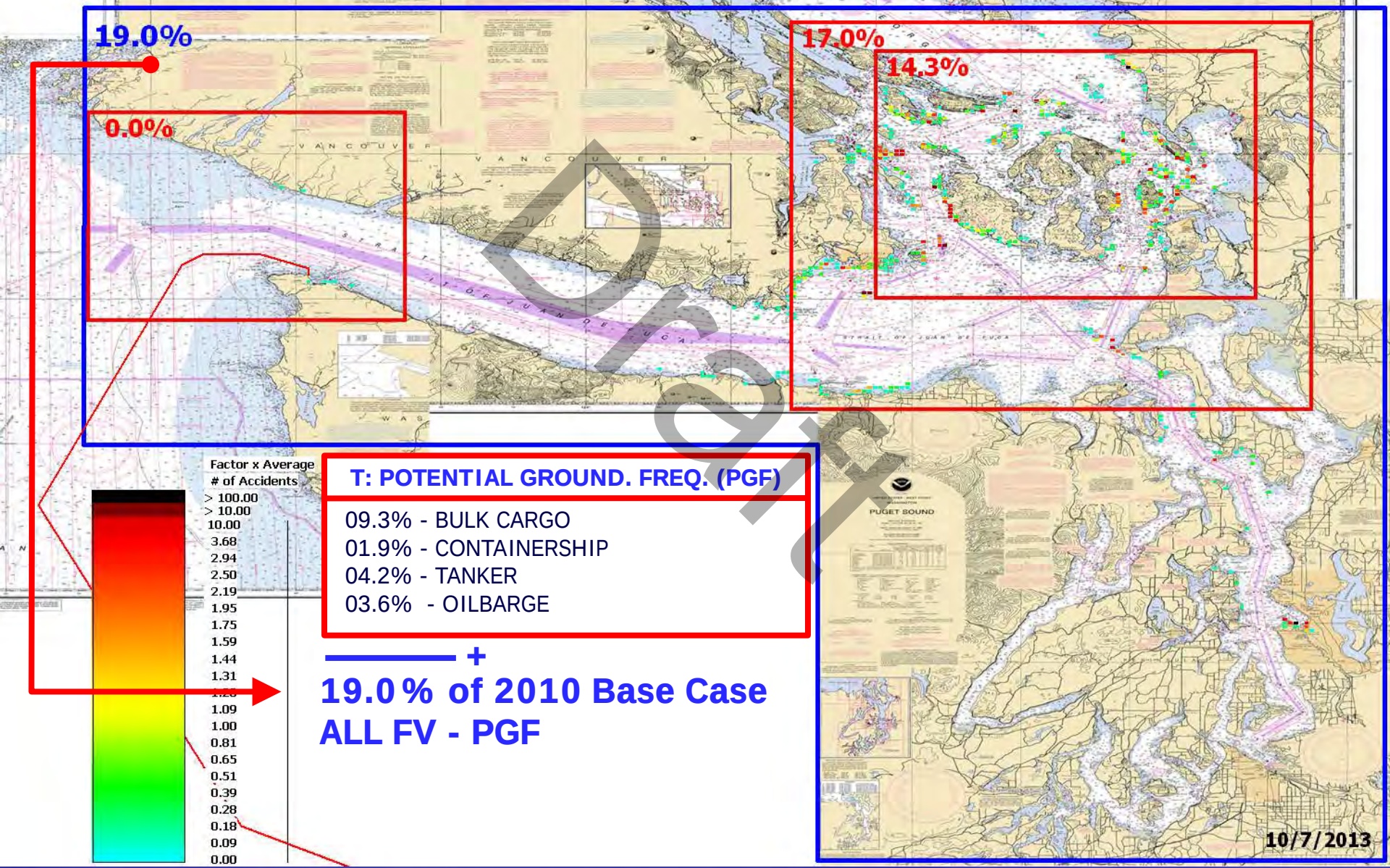
T: VTRA 2010 - GW 487- KM 348 - DP Cont. 67 and Bulk 348



T: POTENTIAL GROUND. FREQ. (PGF)

09.3% - BULK CARGO
01.9% - CONTAINERSHIP
04.2% - TANKER
03.6% - OILBARGE

\+

19.0 % of 2010 Base Case ALL FV - PGF

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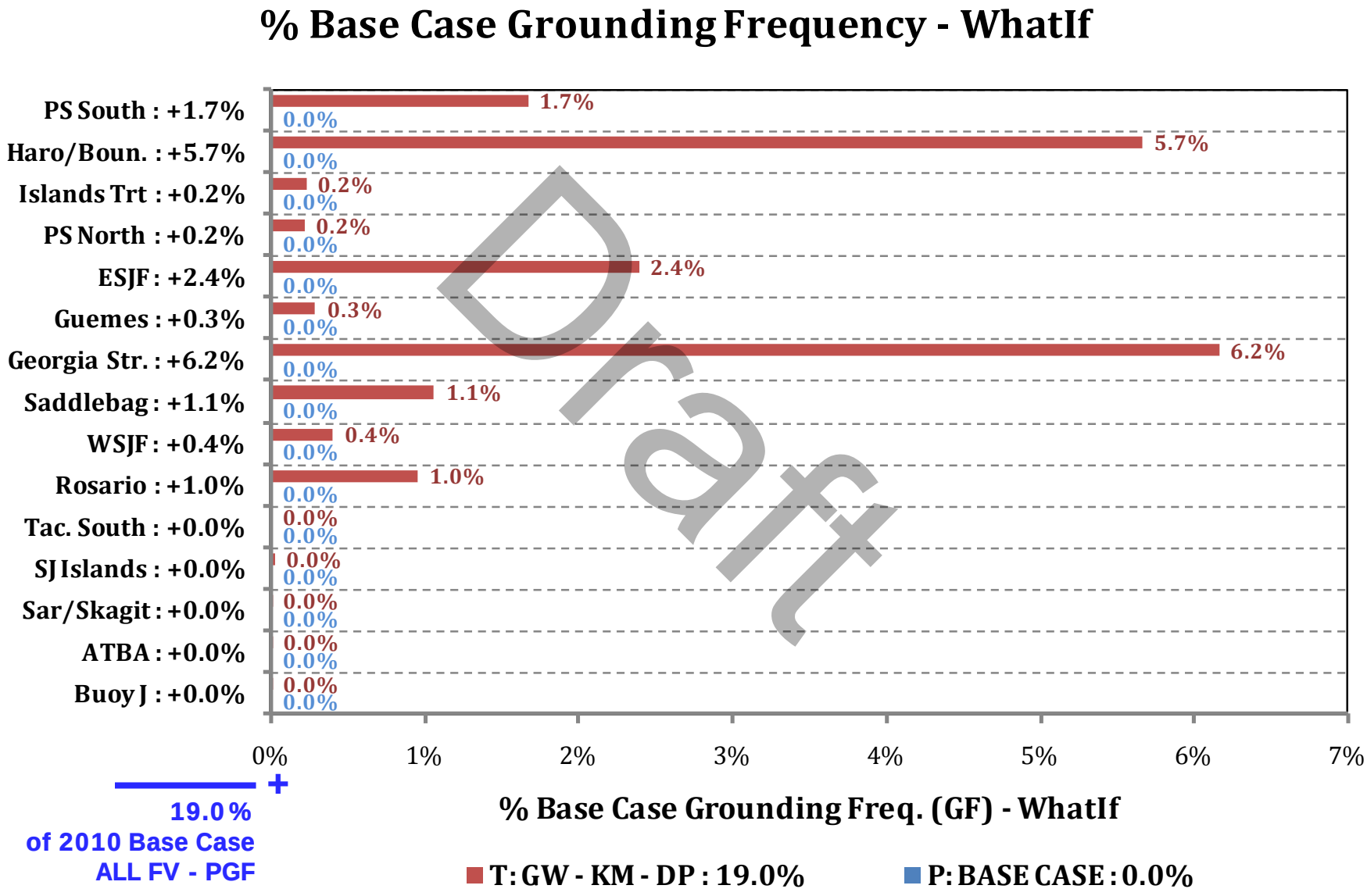
WATERWAY LOCATION
Potential Grounding Freq. Comparison – WHAT-IF FV



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P: BASE CASE CARGO FV POTENTIAL GROUNDING FREQUENCY (PGF)

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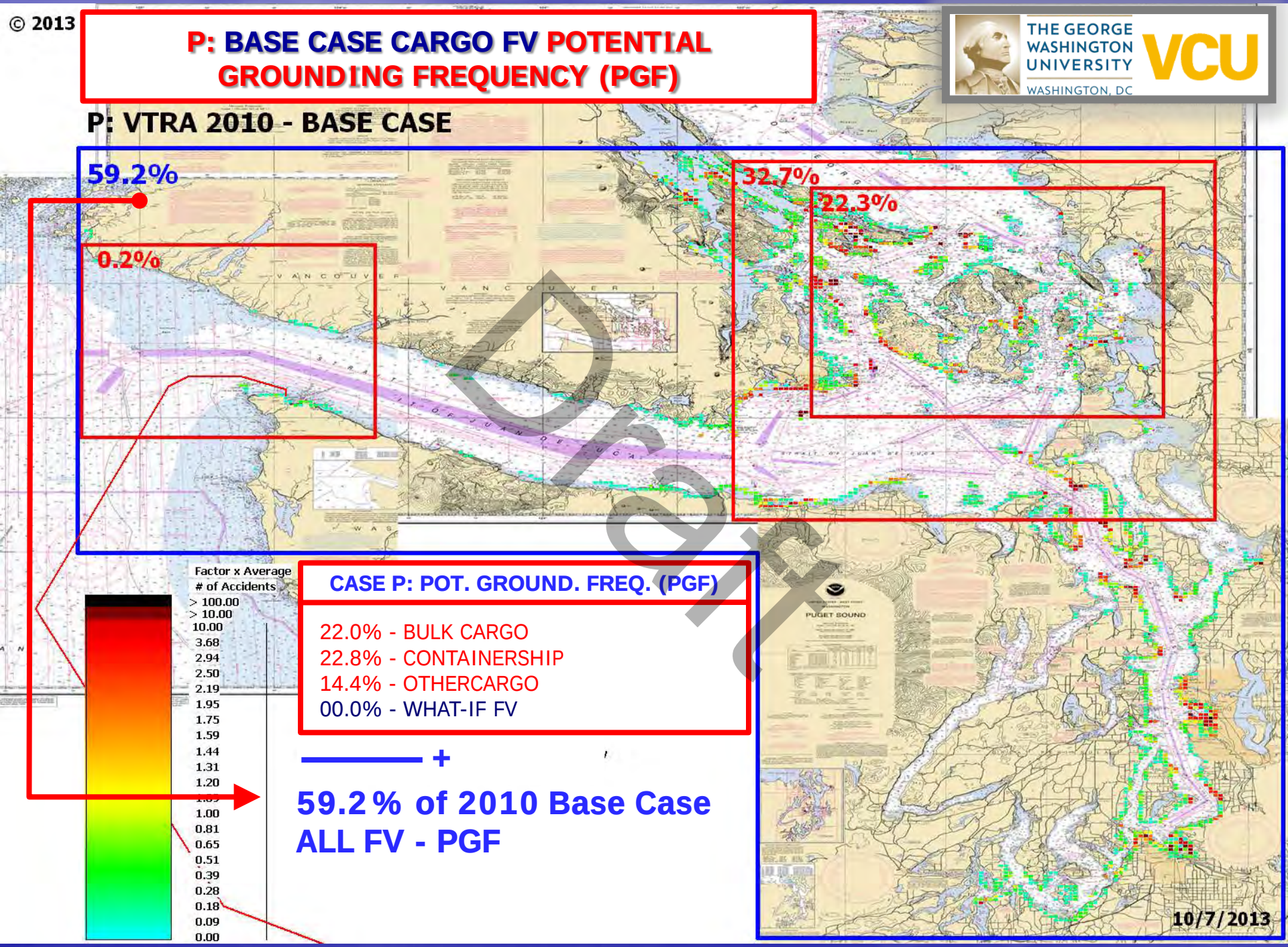
P: VTRA 2010 - BASE CASE



CASE P: POT. GROUND. FREQ. (PGF)

22.0% - BULK CARGO
22.8% - CONTAINERSHIP
14.4% - OTHERCARGO
00.0% - WHAT-IF FV

\+

59.2% of 2010 Base Case ALL FV - PGF

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T: BASE CASE CARGO FV POTENTIAL GROUNDING FREQUENCY (PGF)

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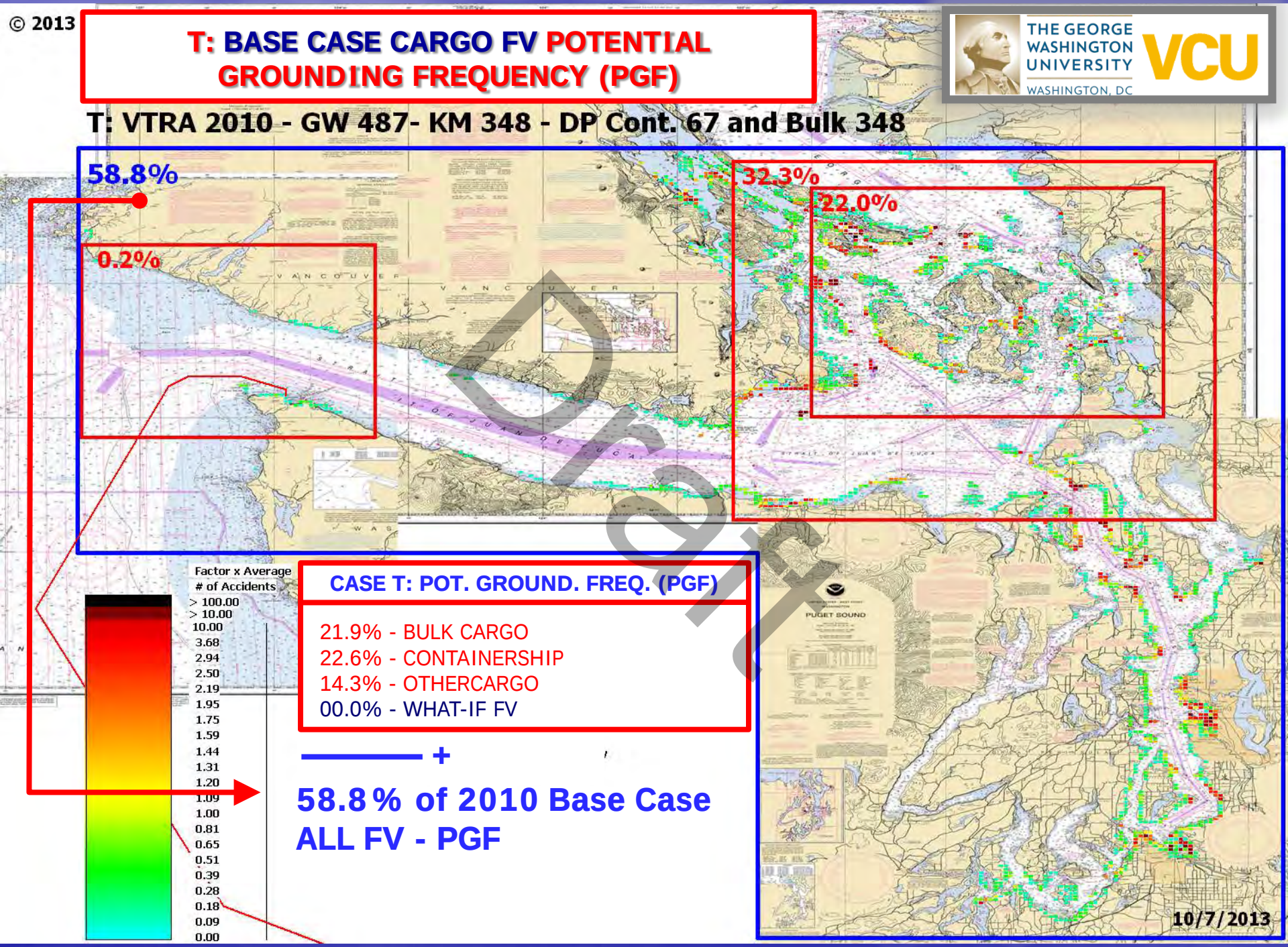
T: VTRA 2010 - GW 487- KM 348 - DP Cont. 67 and Bulk 348



CASE T: POT. GROUND. FREQ. (PGF)

21.9% - BULK CARGO
22.6% - CONTAINERSHIP
14.3% - OTHERCARGO
00.0% - WHAT-IF FV

\+

58.8% of 2010 Base Case ALL FV - PGF

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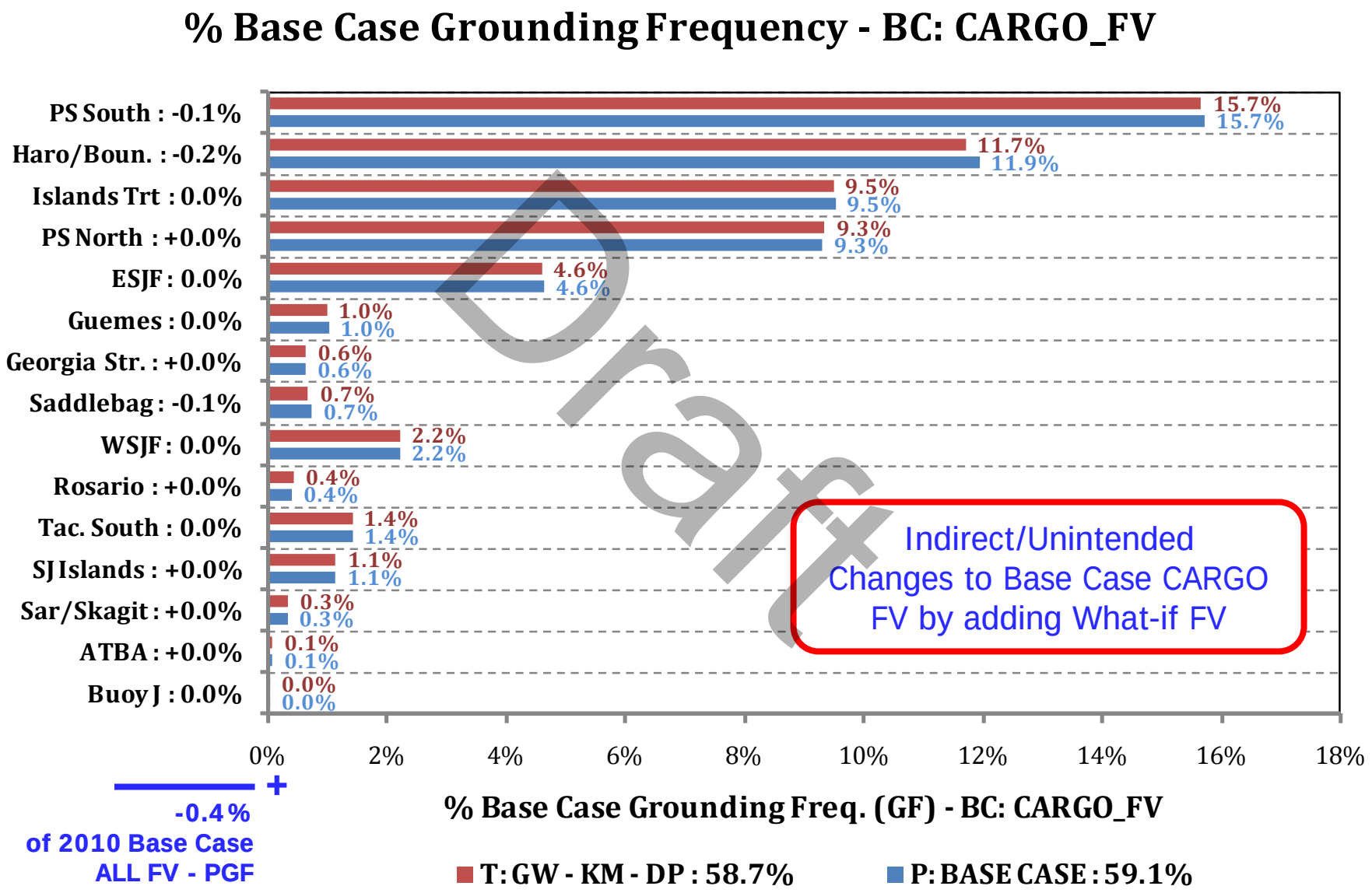
WATERWAY LOCATION
Potential Grounding Freq. Comparison – CARGO FV



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P: BASE CASE TANK FV POTENTIAL GROUNDING FREQUENCY (PGF)

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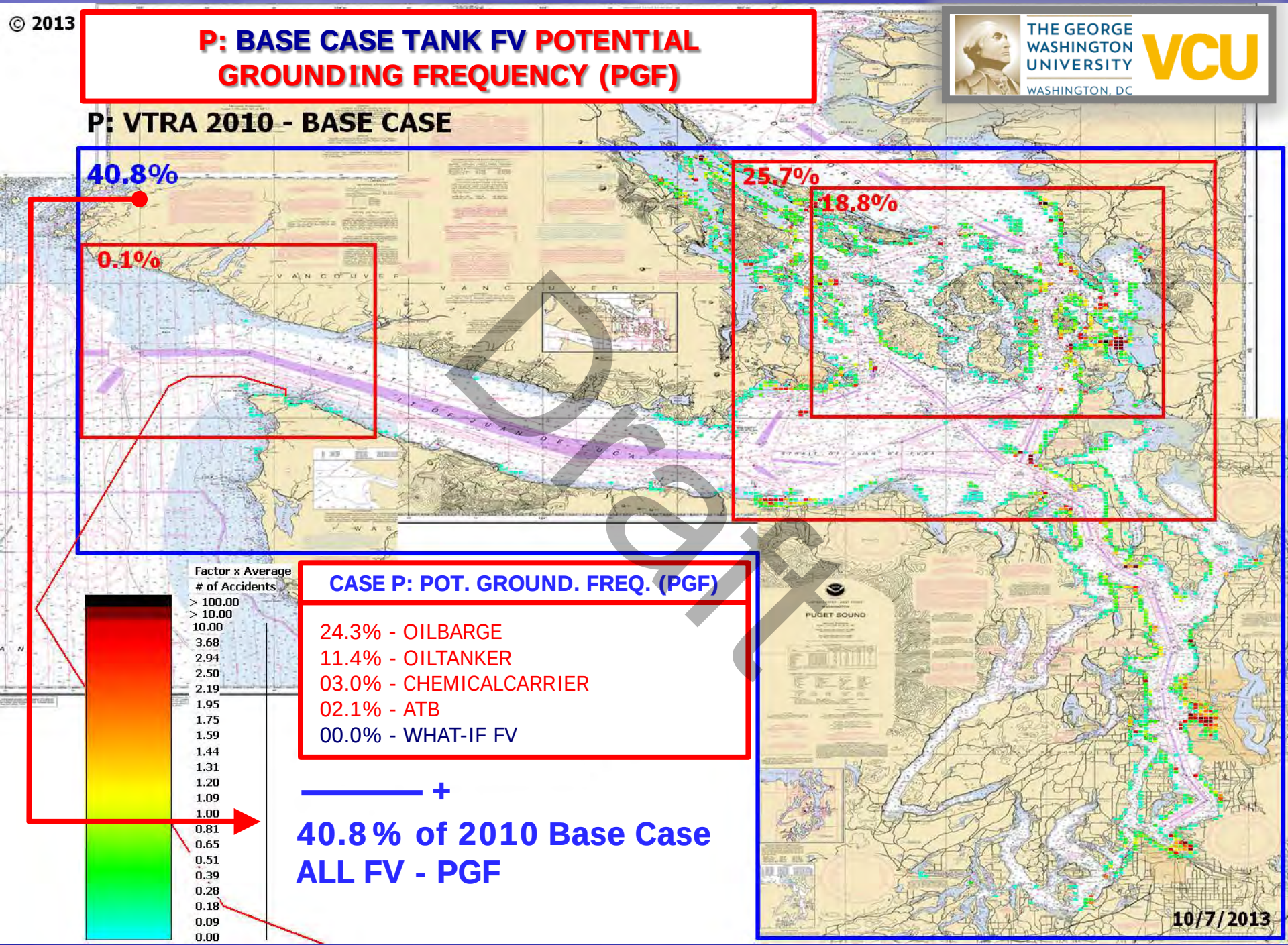
P: VTRA 2010 - BASE CASE



CASE P: POT. GROUND. FREQ. (PGF)

24.3% - OILBARGE
11.4% - OILTANKER
03.0% - CHEMICALCARRIER
02.1% - ATB
00.0% - WHAT-IF FV

\+

40.8% of 2010 Base Case ALL FV - PGF

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T: BASE CASE TANK FV POTENTIAL GROUNDING FREQUENCY (PGF)

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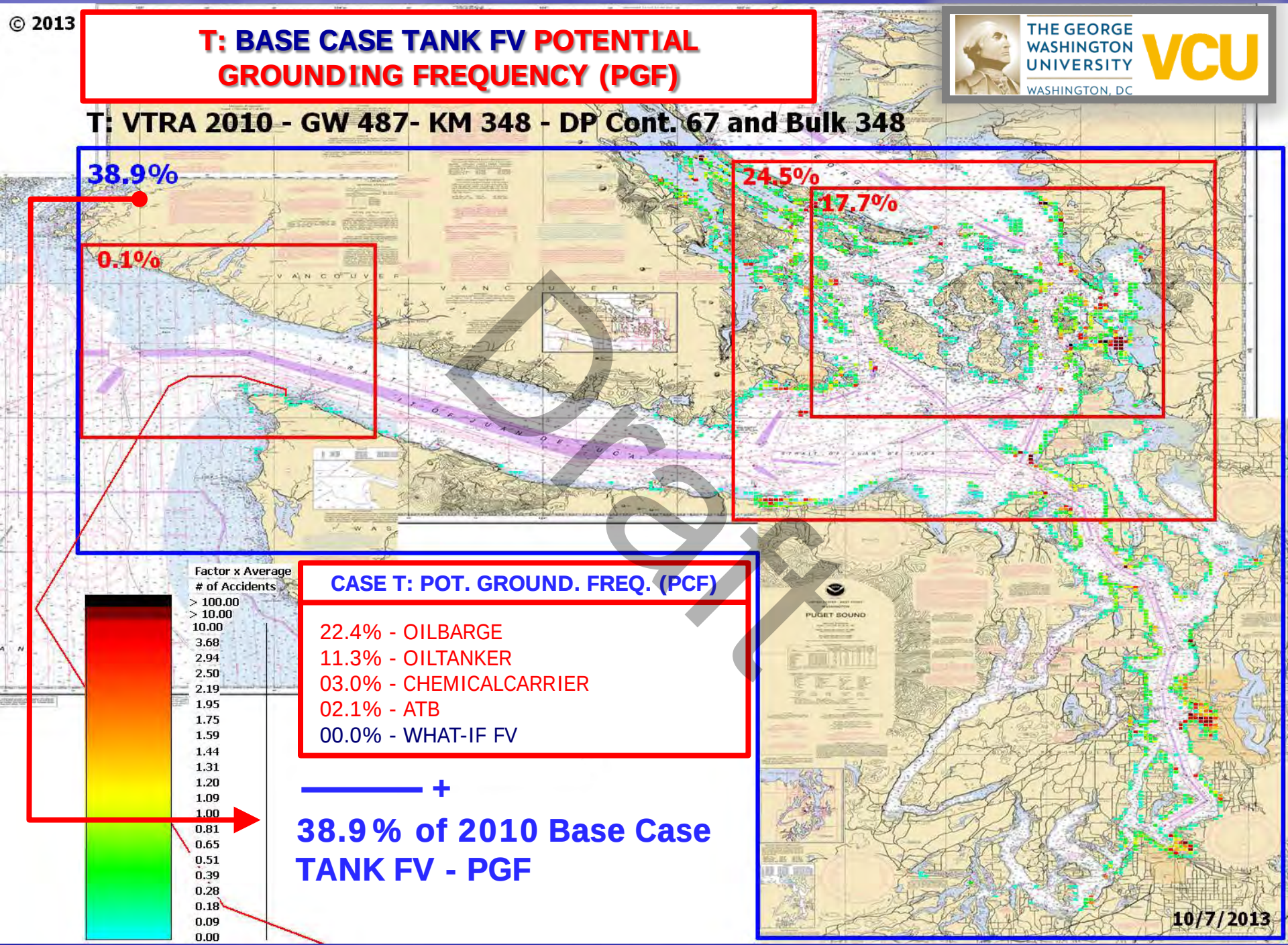
T: VTRA 2010 - GW 487- KM 348 - DP Cont. 67 and Bulk 348



CASE T: POT. GROUND. FREQ. (PCF)

22.4% - OILBARGE
11.3% - OILTANKER
03.0% - CHEMICALCARRIER
02.1% - ATB
00.0% - WHAT-IF FV

\+

38.9% of 2010 Base Case TANK FV - PGF

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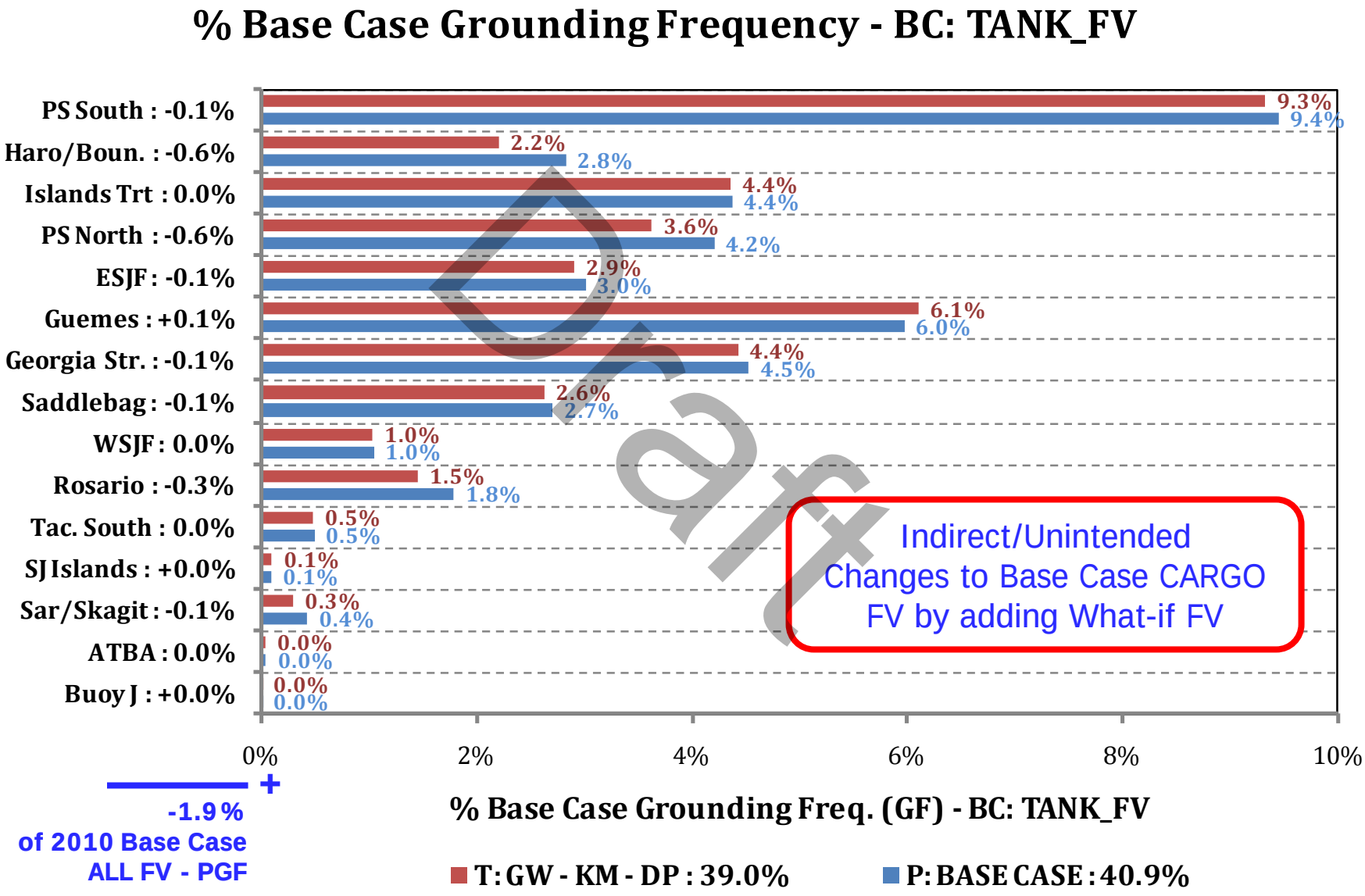
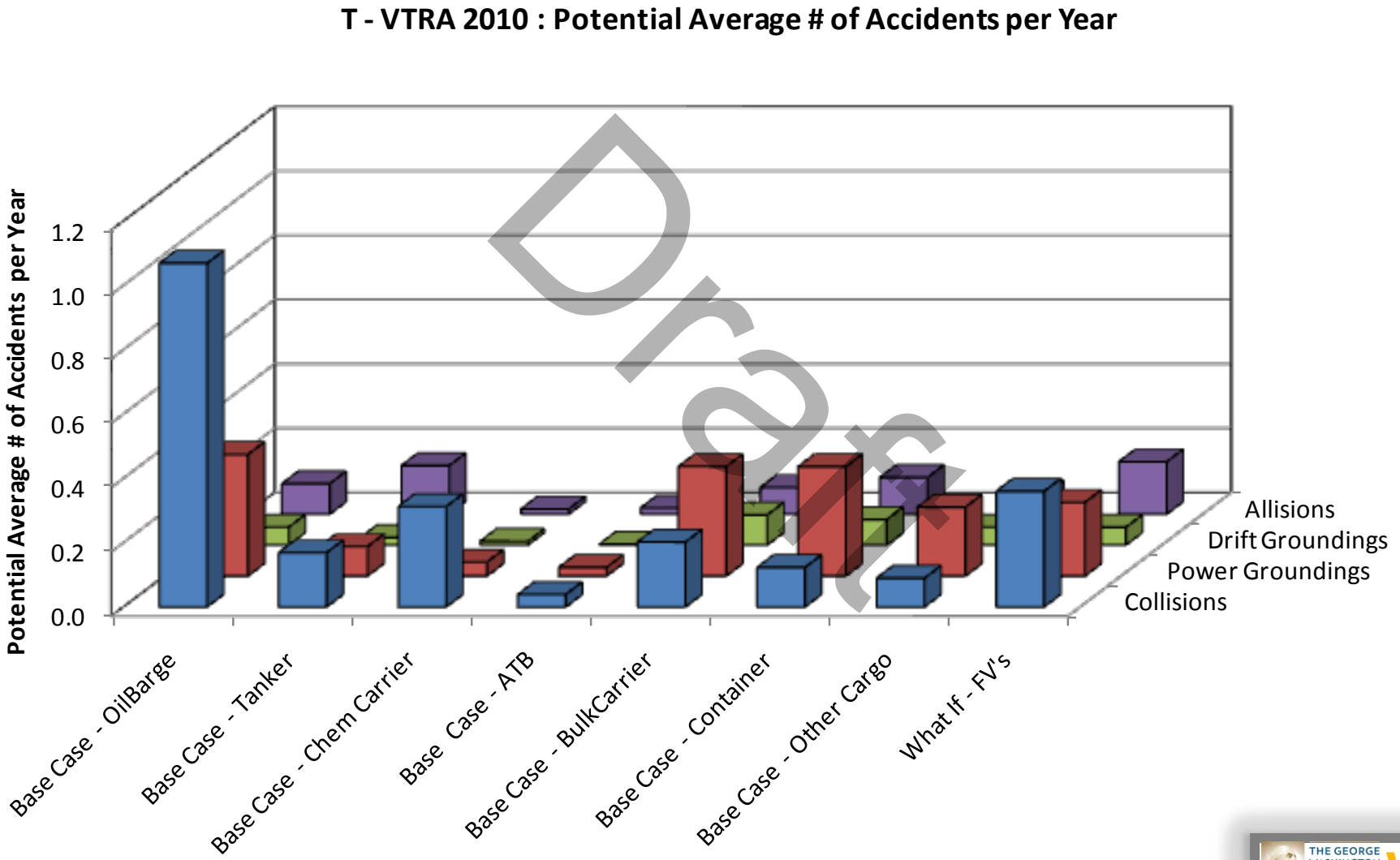
WATERWAY LOCATION
Potential Grounding Freq. Comparison – TANK FV



A TAXONOMY OF 2010 FOCUS VESSEL POTENTIAL ACCIDENT FREQUENCY AND ACCIDENT TYPE

CASE T: GW 487, KM 348, DP 348 and 67:



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CASE T: GW 487, KM 348, DP 348 and 67:

T - VTRA 2010 : Potential Average # of Accidents per Year

Focus Vessel	Collisions	Power Groundings	Drift Groundings	Allisions	Total
Base Case - OilBarge	54.5%	25.5%	17.1%	17.3%	37.0%
Base Case - Tanker	8.6%	6.2%	7.1%	27.6%	10.1%
Base Case - Chem Carrier	15.9%	2.9%	3.6%	2.9%	8.9%
Base Case - ATB	2.0%	1.8%	1.0%	3.5%	2.1%
Base Case - All Tank FV's	81.1%	36.5%	28.8%	51.4%	58.0%
Base Case - BulkCarrier	10.3%	23.0%	28.5%	15.2%	16.7%
Base Case - Container	6.3%	22.9%	24.1%	20.8%	15.2%
Base Case - Other Cargo	4.6%	14.5%	17.1%	12.0%	9.9%
Base Case - All Cargo FV's	21.1%	60.4%	69.7%	48.1%	41.7%
Base Case - All FV's	102.2%	96.9%	98.4%	99.4%	99.8%
What If - FV's	18.4%	15.5%	16.8%	29.8%	18.7%
Total - Base Case + What- IF	120.6%	112.4%	115.2%	129.2%	118.5%

T - VTRA 2010 : Potential Average # of Accidents per Year

Focus Vessel	Collisions	Power Groundings	Drift Groundings	Allisions	Total
Base Case - OilBarge	1.07	0.38	0.06	0.09	1.60
Base Case - Tanker	0.17	0.09	0.02	0.15	0.44
Base Case - Chem Carrier	0.31	0.04	0.01	0.02	0.38
Base Case - ATB	0.04	0.03	0.00	0.02	0.09
Base Case - All Tank FV's	1.59	0.54	0.09	0.28	2.51
Base Case - BulkCarrier	0.20	0.34	0.09	0.08	0.72
Base Case - Container	0.12	0.34	0.08	0.11	0.66
Base Case - Other Cargo	0.09	0.21	0.06	0.07	0.43
Base Case - All Cargo FV's	0.41	0.89	0.23	0.26	1.80
Base Case - All FV's	2.00	1.44	0.32	0.54	4.31
What If - FV's	0.36	0.23	0.06	0.16	0.81
Total - Base Case + What- IF	2.36	1.66	0.38	0.71	5.11

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