Chesapeake Bay Entrance Vessel Incident Report

Introduction

This report shows traffic incident frequencies for the Coastal Virginia Offshore Wind (CVOW) commercial and North Carolina (Kitty Hawk) BOEM wind lease areas, calculated using the IALA Waterways Risk Assessment Program (IWRAP) software. IWRAP is a tool that assists in quantifying the risks involved with vessel traffic in a specified geographic area. On the basis of a sample traffic intensity and composition, the tool allows the user to efficiently evaluate and estimate the annual number of allisions, collisions and groundings in a modeled area. The fundamental calculation used by IWRAP is:

Collision Frequency = Causation Factor x Geometric Frequency

The causation factor is the probability that the officer on watch does not react in time, given they are on collision course with another vessel or structure, or grounding. A set of causation factors was developed by International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) in cooperation with the academic community, that define a set of globally applicable values. This causation factor set is based on Bayesian statistics and rooted in studies of past incidents. The software provides the opportunity to alter the causation factors, however the factors developed by IALA were used in this report.

Geometrical Frequency is the number of candidates for collisions that exist in an AIS Data set. After an AIS data set is uploaded, a density plot is used to identify the most frequented routes. A network is then developed by assigning legs connected by waypoints to the highest density routes. These legs and waypoints are then assigned statistical distributions based on the AIS data, that model the probability vessels of a certain type and length will pass on that leg, the direction traveled, and how far from the center of the leg they travel. These distributions are used to determine the number of opportunities for a collision to take place.

Structures and bathymetry are also included in the model. Structures are modeled by creating a georeferenced representation of size and shape, and are uploaded directly in shapefile format. Bathymetry comes directly from ENC data and also uploaded directly in shapefile format. Both are used in conjunction with the AIS data to determine the geometrical opportunities for an allision or grounding to take place.

The resulting collision frequencies from multiplying causation factors and geometrical frequencies represent the probability that a defined incident will take place. The categories of incidents are:

1. Powered Grounding,
2. Drifting Grounding,
3. Total Groundings,
4. Powered Allision,
5. Drifting Allision,
6. Total Allisions,
7. Overtaking (collision),
8. Crossing (collision),
9. Head on (collision),
10. Merging (collision), and
11. Bend (collisions),
12. Total Collisions.

Head on collisions take place when two vessels are on the same leg moving in reciprocal directions. Overtaking collisions take place when two vessels are on the same leg moving the same direction. Crossing collisions take place when two legs cross at a waypoint. Merging collisions take place when several legs merge at a waypoint. Finally, bend collisions take place when ships on the same leg make a turn at a waypoint.

Head-on	Overtaking

Bend	Crossing	Merging
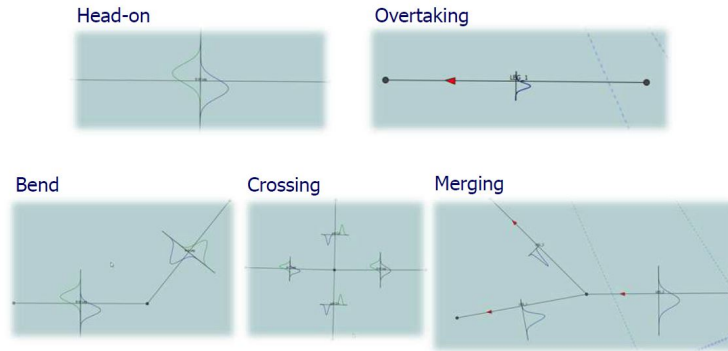
Collision frequencies observed as incidents per year are the probabilities a certain type of incident will take place in any given year assuming the traffic makeup is similar to the sample year. For example, with a value of .22201 powered grounding incidents per year there is roughly a 22% chance a powered grounding will take place in a given year. The frequencies can also be observed as years between incidents which is the inverse of incidents per year. The same .22201 powered groundings per year is $.22201^{-1} = 4.5043$ years between powered grounding incidents.

In this analysis three models were considered, referred to as Alpha, Bravo and Charlie. The Alpha case is the baseline model in which no structures exist, and represents the probability that incidents will take place in the sample year. Since there are no structures in this model, allision frequencies do not exist. The Bravo case assumes that traffic does not alter patterns and adds in the fully developed wind lease blocks. Bravo is the worst-case scenario, that shows the maximum allision frequencies the projects may present. The Charlie case includes some reasoned assumptions on how mariners will respond to the fully developed wind lease blocks used. For example, larger ships are unlikely to traverse the lease blocks, and Charlie takes this into account by modifying the statistical distributions assigned to each leg to model traffic routing around. Charlie represents the mostly likely estimate of incident frequencies in the future, and allows observation of the changes to collisions and groundings with the introduction of new traffic patterns based on how mariners are likely to respond to project structures.

For this report:

- AIS data set is all AIS equipped vessel traffic in the vicinity of the Chesapeake Bay Entrance in calendar year 2019. Unlike the Traffic Analysis in Appendix H, coastwise traffic was not excluded. Traffic on north/south courses transiting past the Chesapeake Entrance is also included in this report.
- The structures used in Bravo and Charlie were created by NAVCEN in ArcMAP
  - Assume fully developed lease areas
  - With mono-pile wind turbine generators
  - Base diameter of 10m
  - Evenly spaced evenly at 1 nautical mile.
- Bathymetry was downloaded directly from NOAA's website, encdirect.noaa.gov.

Model Development

The network of legs for Chesapeake Bay Entrance was developed in cooperation with CG District 5 Waterways. The model area extends from mean lower low water to approximately 55 nautical miles offshore and is shown by the shaded area in Figure 1. Also in the Figure 1, vessel traffic density for 2019 is represented on a red, yellow, blue scale. Red is the highest density areas and blue the lowest density. The three colors represent density quantiles with cutoffs at 98 (red), 91(yellow), and 0(blue) with a continuous gradient in between. The Black lines represent the numbered legs connected by waypoints. Each leg has two distributions assigned which were extracted from the AIS data. The green distribution represents inbound traffic and the blue outbound traffic. Enclosure (1) is a full size map of the model area.
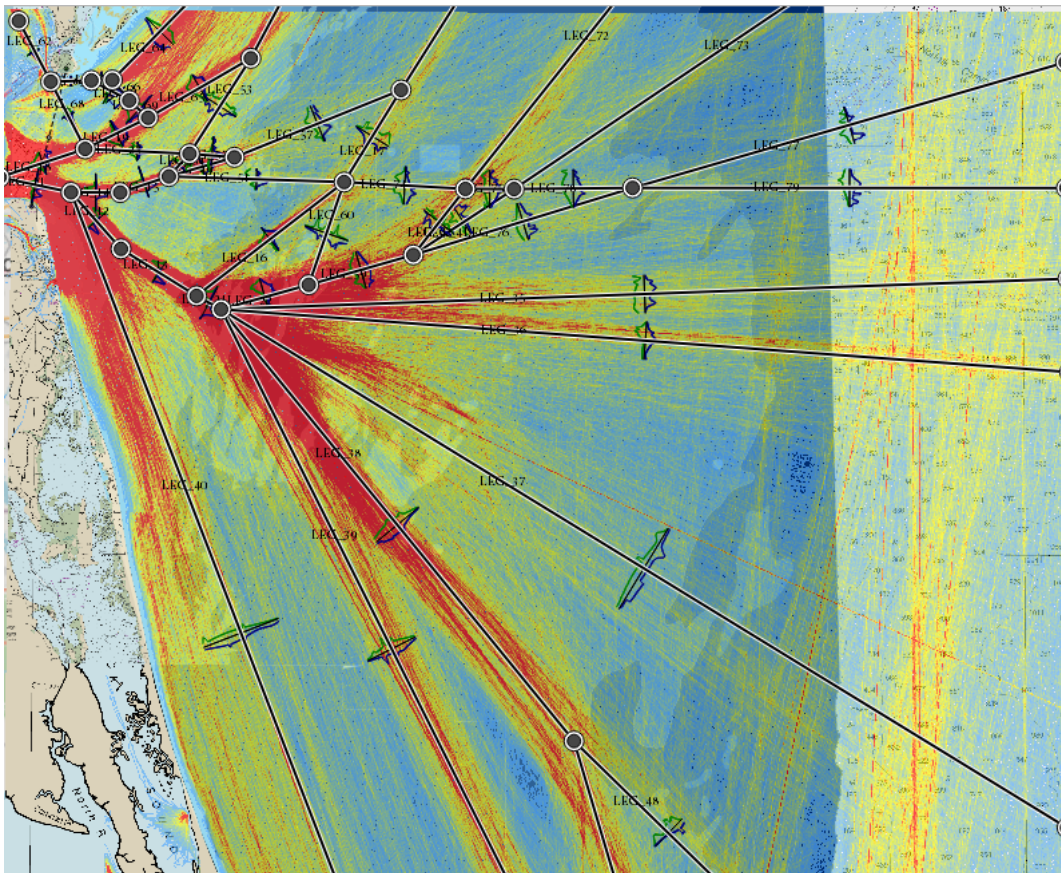

Figure 1: 2019 Traffic Density and Leg network

Alpha

Figure 2 is the baseline model which assigns incident frequencies to each leg, waypoint, and bathymetric line. The highest frequencies are represented by dark blue and lowest frequencies are yellow. Frequency values are in Table 1. Enclosure (2) is a full-size map of the baseline.

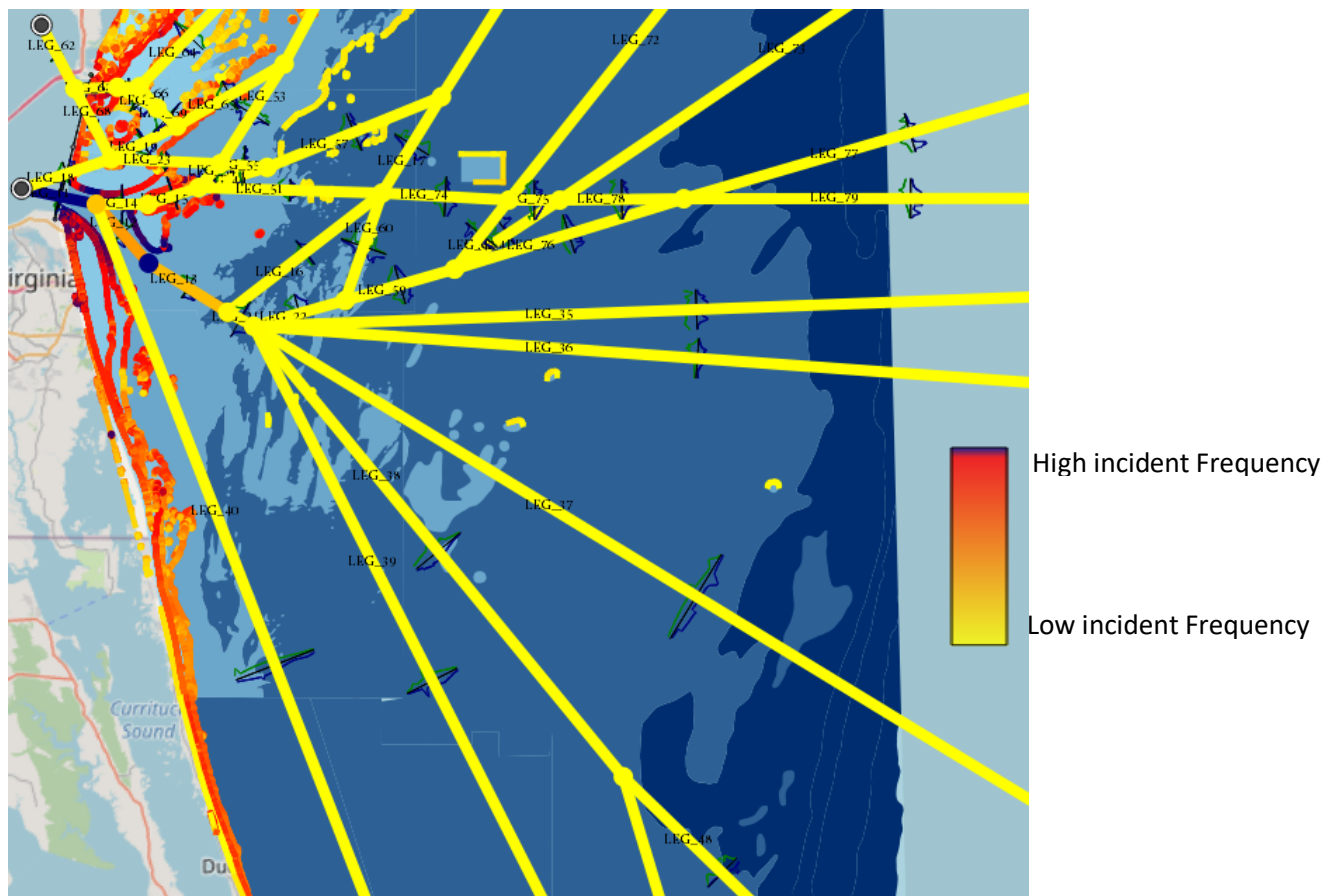|	Incidents/Year	Years Between Incidents
Powered Grounding	0.22201	4.5043
Drifting Grounding	0.051534	19.404
Total Groundings	0.27354	3.6557
Powered Allision	---	---
Drifting Allision	---	---
Total Allisions	---	---
Overtaking	0.001301	768.65
HeadOn	0.001207	828.5
Crossing	0.00024251	4,123.60
Merging	0.00023918	4,181
Bend	0.0060564	165.11
Total Collisions	0.0090461	110.54

Table 1: Alpha Frequency Values

Figure 2: Alpha Model

Bravo

Figure 3 is the Bravo model with the individual wind turbine generators added to the model. Table 2 are the corresponding frequency values. The percentages in Table 2 are the percent change from the baseline. Enclosure (3) is a full-size map of Bravo.

|	Incidents/Year	Years between Incidents
Powered Grounding	(-0.000%) 0.22201	(0.000%) 4.5043
Drifting Grounding	(-0.012%) 0.051528	(0.012%) 19.407
Total Groundings	(-0.002%) 0.27354	(0.002%) 3.6558
Powered Allision	0.015676	63.792
Drifting Allision	0.00047858	2,089.50
Total Allisions	0.016154	61.902
Overtaking	(-0.000%) 0.001301	(0.000%) 768.66
HeadOn	(0.000%) 0.001207	(-0.000%) 828.5
Crossing	(0.000%) 0.00024251	(0.000%) 4,123.6
Merging	(0.000%) 0.00023918	(0.000%) 4,181
Bend	(0.000%) 0.0060564	(0.000%) 165.11
Total Collisions	(0.000%) 0.0090461	(-0.000%) 110.54

Table 2: Bravo Frequency Values
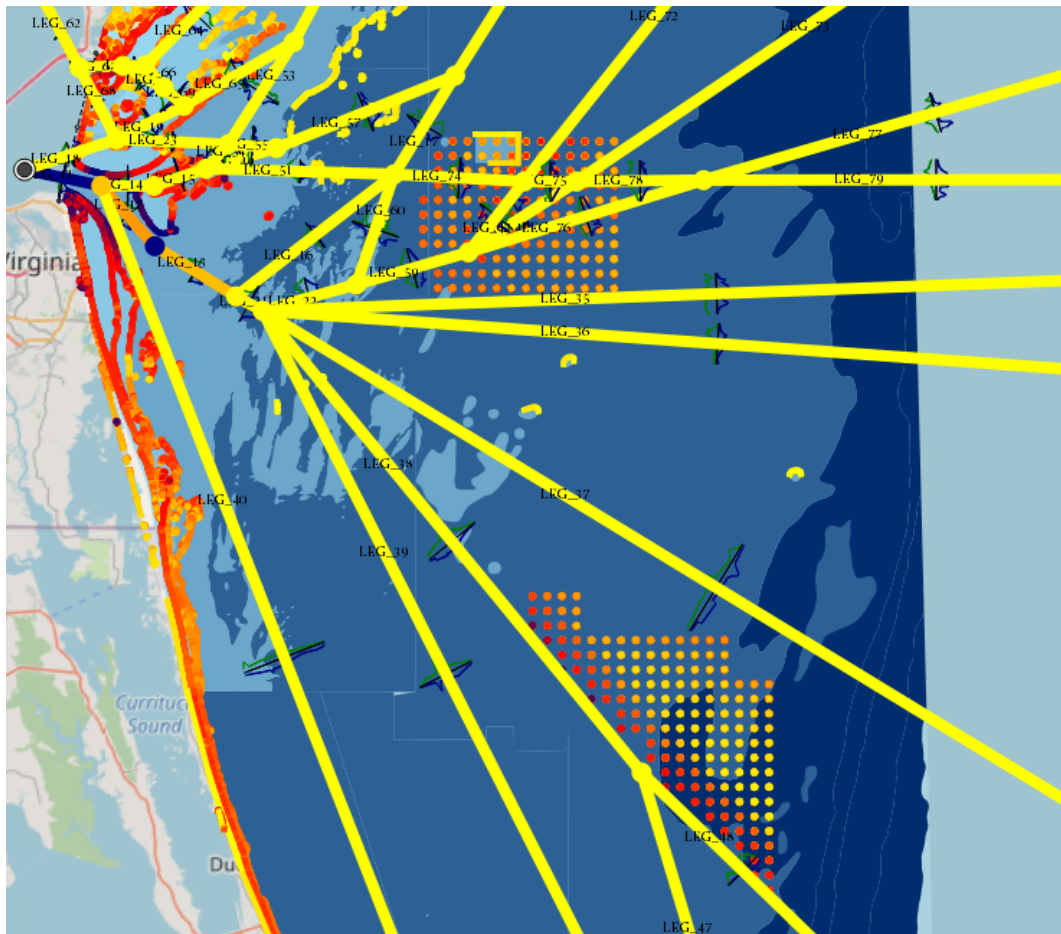
Figure 3: Bravo Model

Charlie

Figure 4 is the Charlie model. Enclosure (4) is a full-size map of Charlie. The following is a summary of changes made to traffic patterns:

- Legs 16, 74,75,78, and 79 which ran due east/west through the northern portion of the CVOW commercial area were renamed North 1,2,3,4,5 respectively.
- Legs 22, 59, 76, 41 ,42 which ran North East /South West through the CVOW commercial area were renamed RR 1,2,3,4,5 respectively
- Leg 35 was renamed South 1 and a new leg, South 2, was created to connect South 1 to NE outbound legs and SW inbound legs.
- The "North" legs were moved to route around the CVOW commercial area to the north. The traffic distributions on those legs were not altered by moving them.
- The traffic makeup on the "RR legs" was copied and half moved to South 1 and 2 and half to North 1 -5 legs. At this point the traffic distributions were altered to include the traffic that historically traveled on the RR legs.
- Finally, the traffic represented on the RR legs was removed. The red arrows on those legs in Figure 4 denote empty routes.

	Incidents/Year	Years between Incidents
Powered Grounding	(-18.502%) 0.18937	(22.703%) 5.28066
Drifting Grounding	(-8.485%) 0.045249	(9.272%) 22.0999
Total Groundings	(-16.615%) 0.23462	(19.926%) 4.2622
Powered Allision	0.010485	95.3743
Drifting Allision	0.00039457	2,534.40
Total Allisions	.010880	91.9117
Overtaking	(106.280%) 0.0204190	(-51.522%) 489.73
HeadOn	(24.518%) 0.00174920	(-19.690%) 571.68
Crossing	(106.298%) 0.00034182	(-51.526%) 2,925.51
Merging	(122.881%) 0.00053398	(-55.133%) 1,872.72
Bend	(62.676%) 0.0095668	(-38.528%) 104.52
Total Collisions	(66.617%) 0.014234	(-39.982%) 70.254

Table 3: Charlie Frequency Values

Figure 5 is the Charlie model revisions shown with the wind energy areas (transparent yellow) and proposed fairways (solid brown). Enclosure (5) is the full size map of the same.
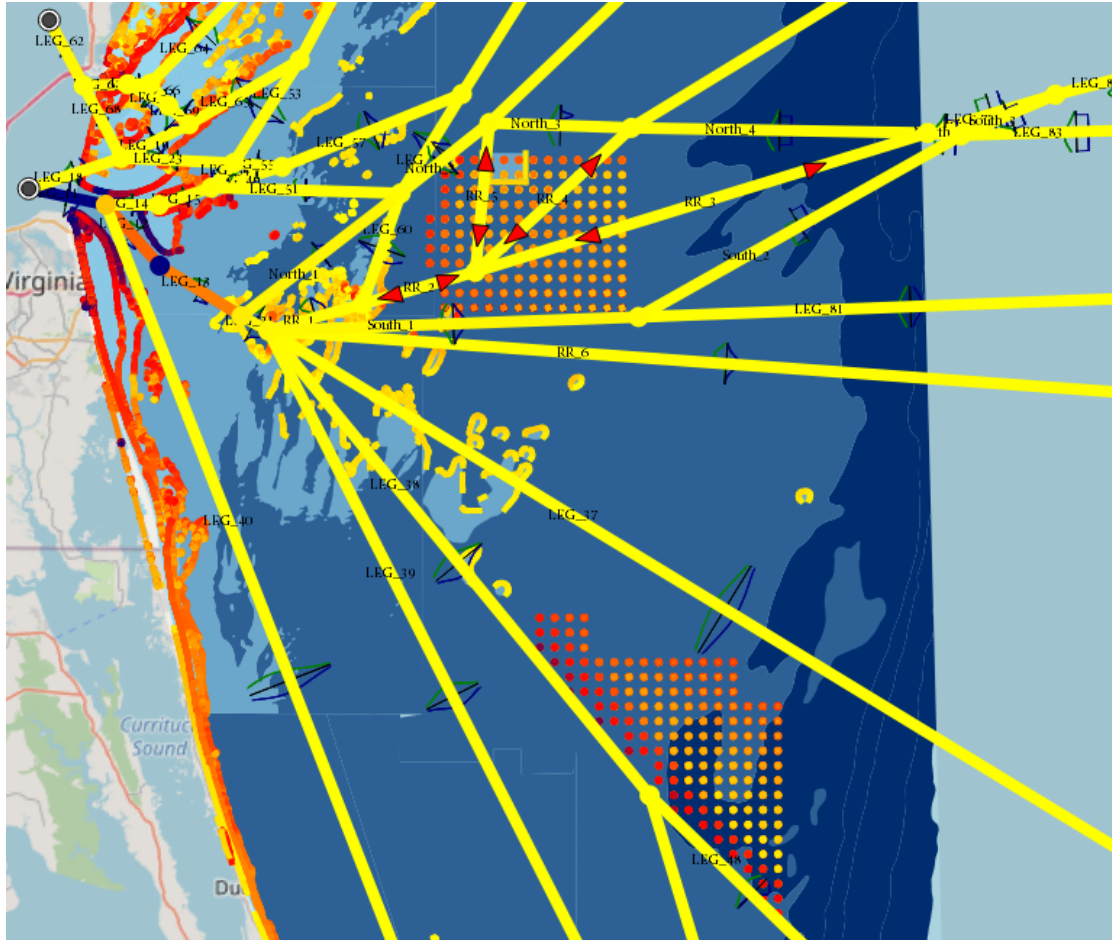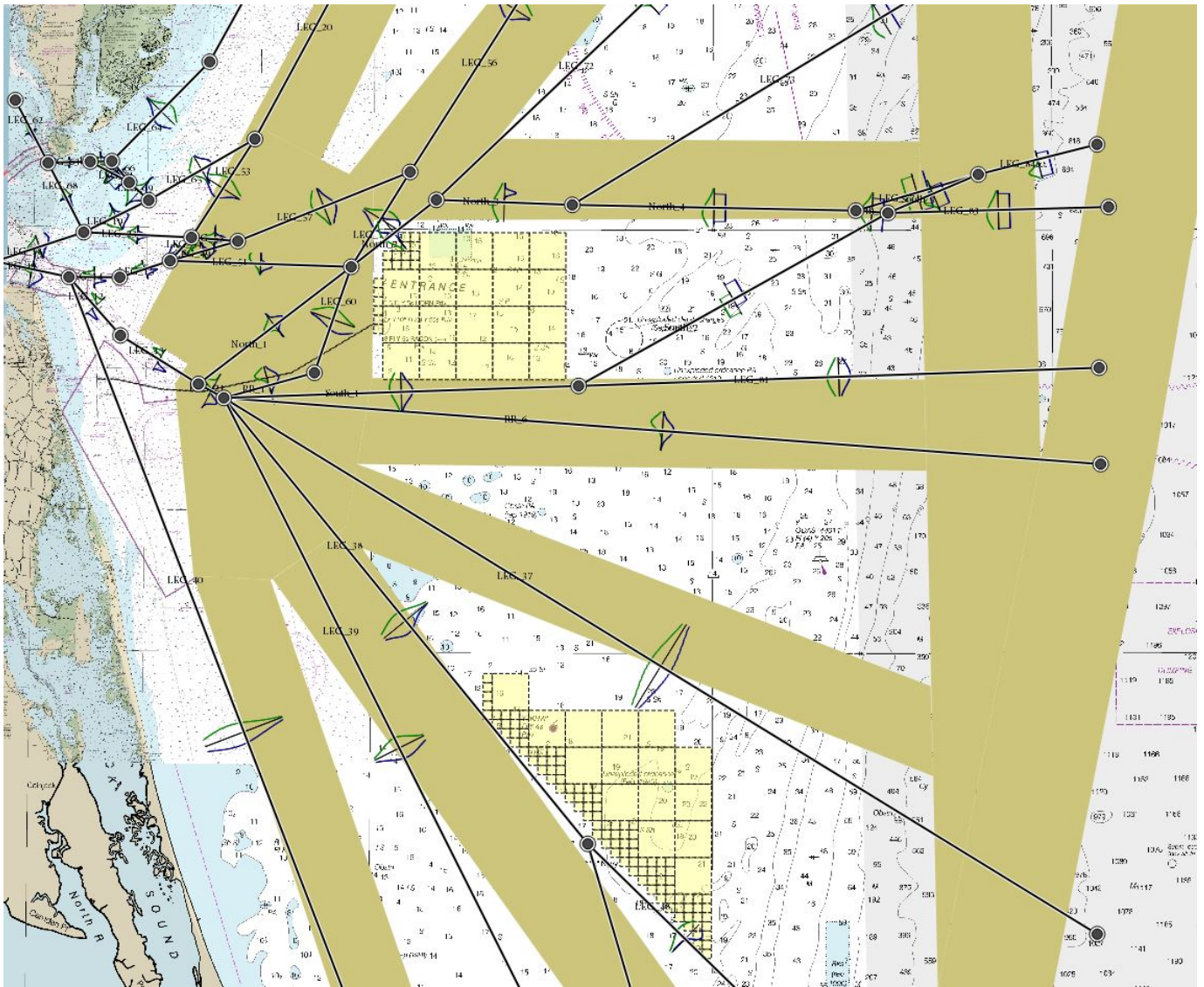
Figure 4: Charlie Model

Figure 5: Predicted traffic patterns with proposed Fairways.

Results Comparison

	Alpha	Bravo	Charlie
Powered Grounding	0.22201	(-0.000%) 0.22201	(-18.502%) 0.18093
Drifting Grounding	0.051534	(-0.012%) 0.051528	(-8.485%) 0.047162
Total Groundings	0.27354	(-0.002%) 0.27354	(-16.615%) 0.22809
Powered Allision	---	0.015676	0.011415
Drifting Allision	---	0.00047858	0.00048022
Total Allisions	---	0.016154	0.011895
Overtaking	0.001301	(-0.000%) 0.001301	(106.280%) 0.0026837
HeadOn	0.001207	(0.000%) 0.001207	(24.518%) 0.0015029
Crossing	0.00024251	(0.000%) 0.00024251	(106.298%) 0.00050029
Merging	0.00023918	(0.000%) 0.00023918	(122.881%) 0.00053308
Bend	0.0060564	(0.000%) 0.0060564	(62.676%) 0.0098524
Total Collisions	0.0090461	(0.000%) 0.0090461	(66.617%) 0.015072

Table 4: All models results in Incidents/Year

	Alpha	Bravo	Charlie
Powered Grounding	4.5043	(0.000%) 4.5043	(22.703%) 5.5269
Drifting Grounding	19.404	(0.012%) 19.407	(9.272%) 21.204
Total Groundings	3.6557	(0.002%) 3.6558	(19.926%) 4.3841
Powered Allision	---	63.792	87.605
Drifting Allision	---	2,089.50	2,082.40
Total Allisions	---	61.902	84.068
Overtaking	768.65	(0.000%) 768.66	(-51.522%) 372.63
HeadOn	828.5	(-0.000%) 828.5	(-19.690%) 665.37
Crossing	4,123.60	(0.000%) 4,123.6	(-51.526%) 1,998.8
Merging	4,181	(0.000%) 4,181	(-55.133%) 1,875.9
Bend	165.11	(0.000%) 165.11	(-38.528%) 101.5
Total Collisions	110.54	(-0.000%) 110.54	(-39.982%) 66.347

Table 5: All models results in Years between Incidents
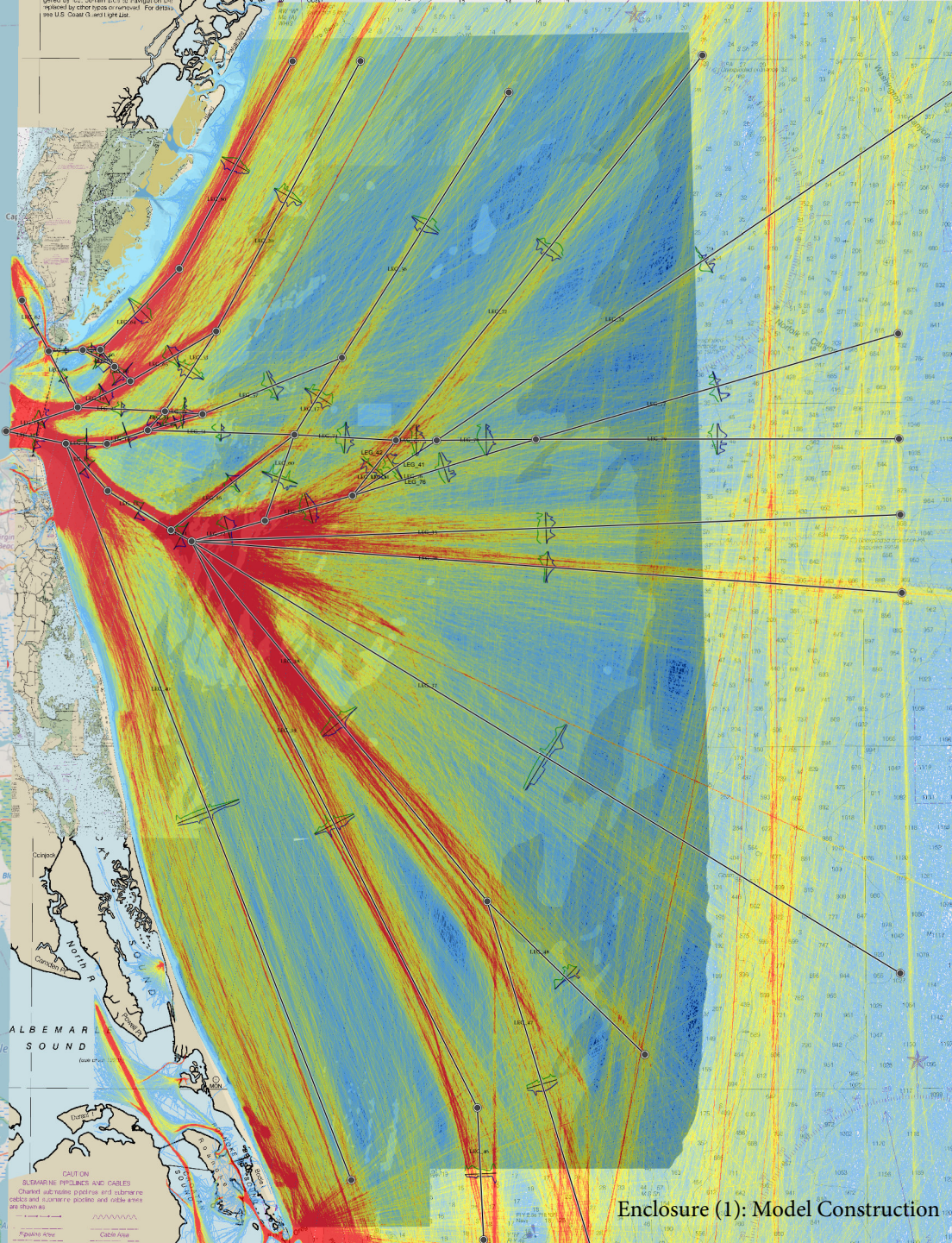
Enclosure (1): Model Construction
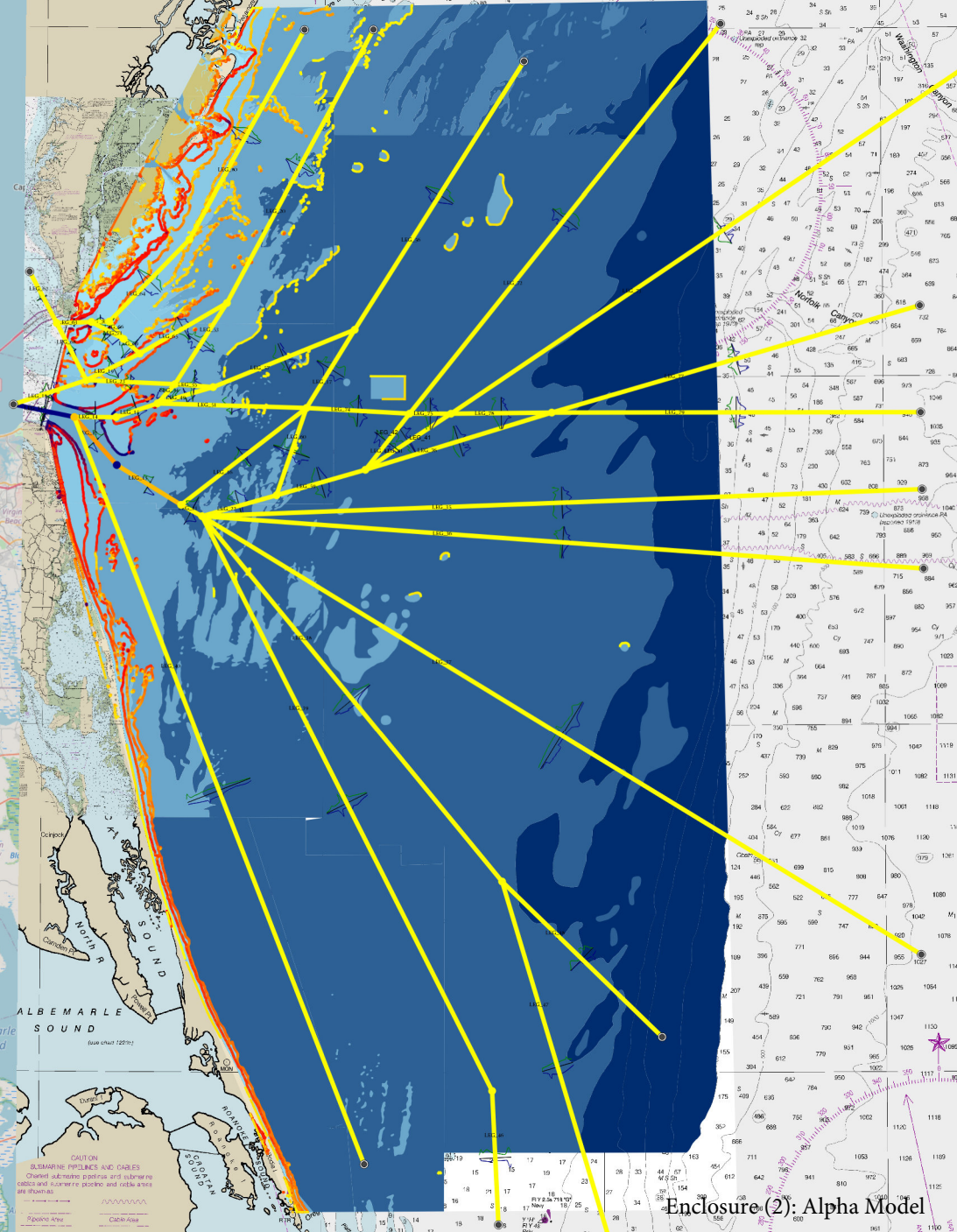
Enclosure (2): Alpha Model
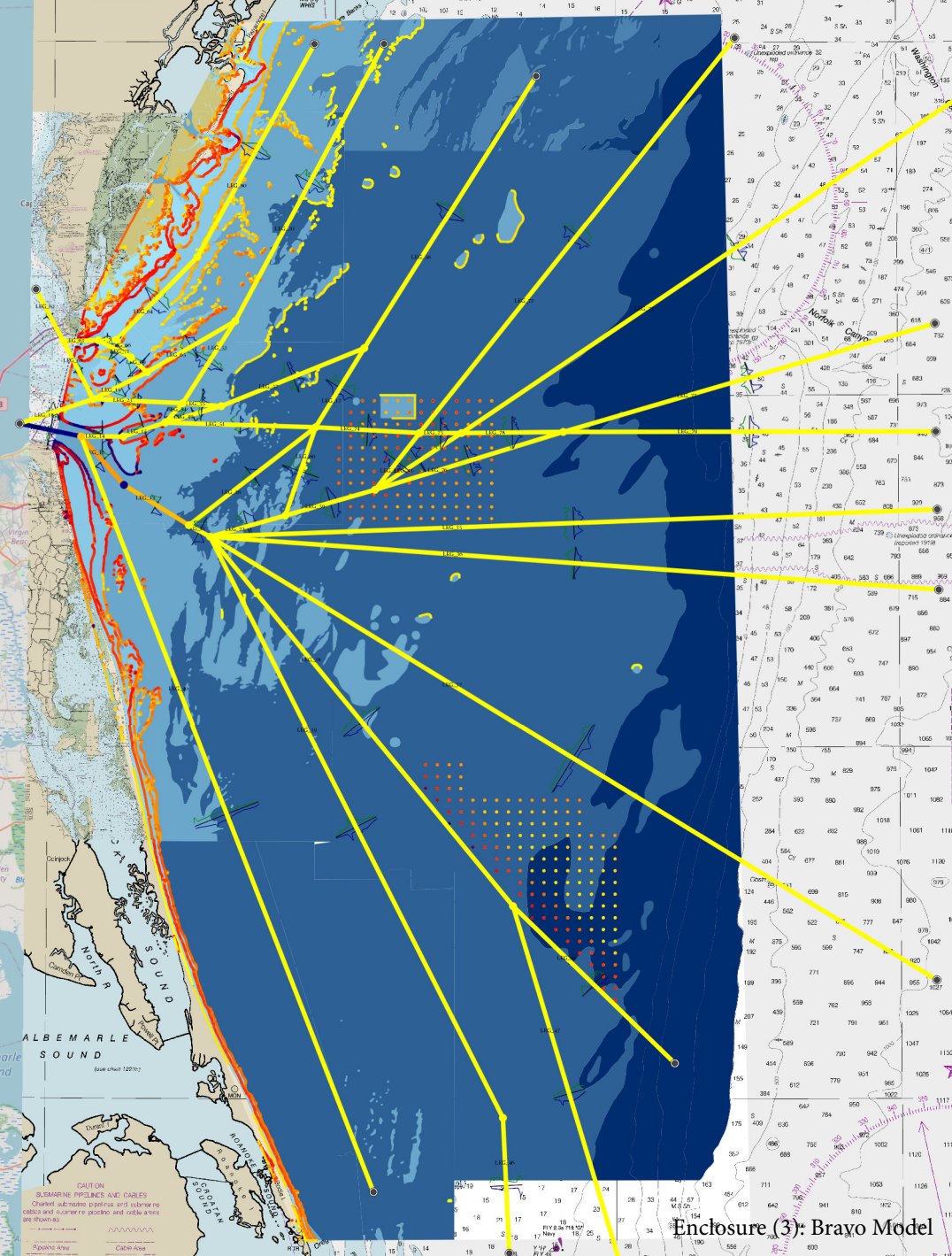
Enclosure (3): Bravo Model
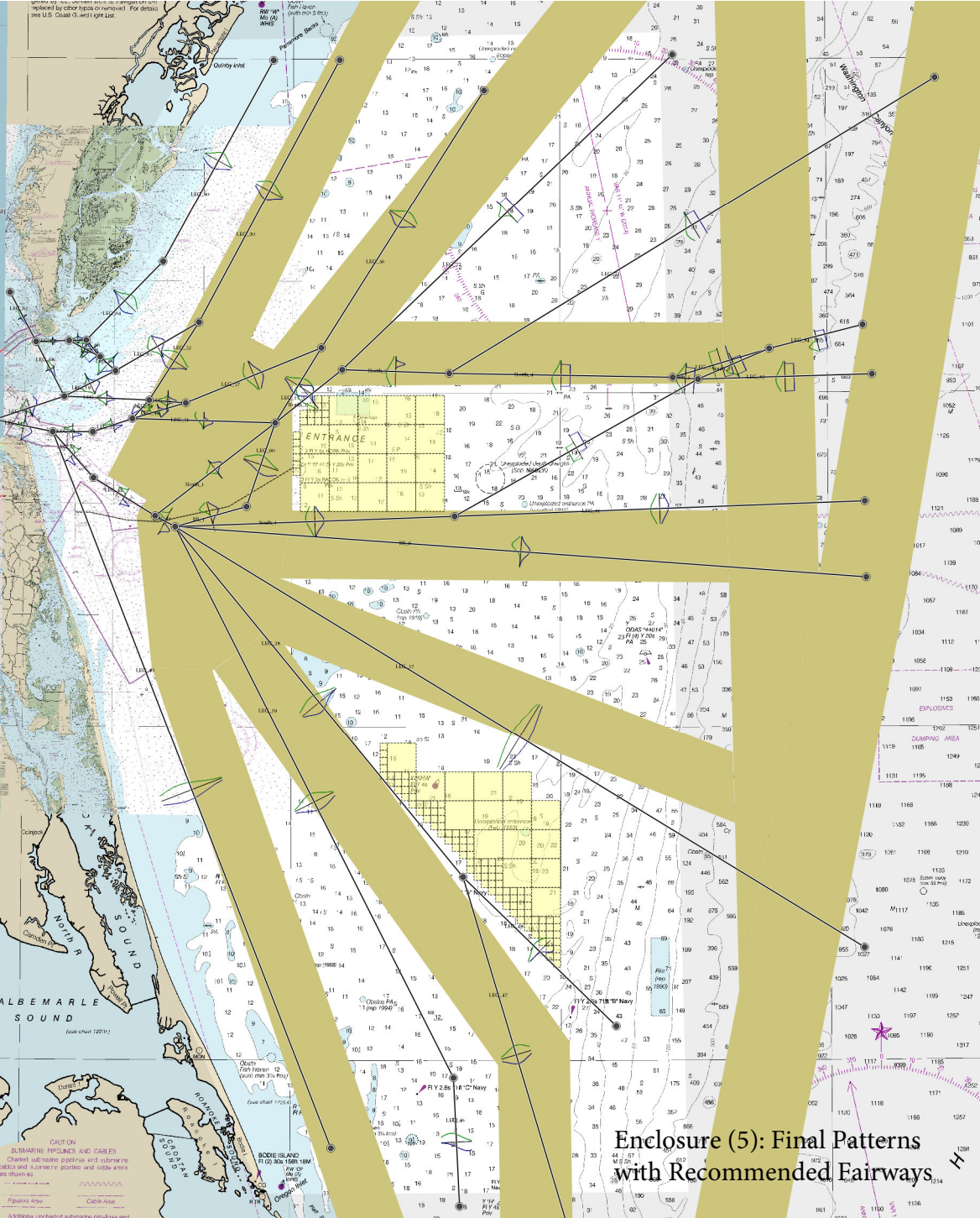
Enclosure (4): Charlie Model

Enclosure (5): Final Patterns
with Recommended Fairways

Ship to Ship Collisions

Alpha

Striking/Struck	Crude oil	Oil products	Chemical	Gas	Container	General cargo	Bulk	Ro-Ro cargo	Passenger	Fast ferry	Support	Fishing	Pleasure	Other	Sum
Crude oil															
Oil products		3.12777e-05				0.000377965			5.65068e-06	7.64784e-09	3.26811e-05	1.13928e-06	5.28568e-06	6.52512e-05	0.000519258
Chemical															
Gas															
Container															
General cargo		0.00041714				0.00476995			7.19388e-05	9.14618e-08	0.000452178	1.40495e-05	6.40883e-05	0.00076741	0.00655684
Bulk															
Ro-Ro cargo															
Passenger		3.15084e-06				3.68038e-05			2.66887e-07	5.02168e-10	1.86393e-06	1.2693e-07	5.04204e-07	4.59141e-06	4.73085e-05
Fast ferry		1.85006e-08				2.80633e-07			9.61873e-10	1.16105e-11	3.31445e-07	1.65083e-08	1.92057e-08	6.52561e-08	7.32523e-07
Support		2.4357e-05				0.000290189			2.49159e-06	4.80211e-08	0.000130403	1.20193e-05	2.16908e-05	6.6937e-05	0.000548135
Fishing		2.11691e-06				2.55497e-05			3.17425e-07	1.85701e-08	2.14887e-05	7.63278e-05	1.62103e-05	9.61439e-06	0.000151644
Pleasure		1.19133e-05				0.000137326			1.86202e-06	1.0313e-08	4.12725e-05	1.62314e-05	1.51033e-05	2.61537e-05	0.000249872
Other		6.16225e-05				0.000706531			7.72974e-06	2.65624e-08	9.4732e-05	6.12156e-06	1.27807e-05	8.2762e-05	0.000972306
Sum		0.000551596				0.00634459			9.02581e-05	2.0309e-07	0.00077495	0.000126032	0.000135682	0.00102278	0.0090461

Bravo

Striking/Struck	Crude oil	Oil products	Chemical	Gas	Container	General cargo	Bulk	Ro-Ro cargo	Passenger	Fast ferry	Support	Fishing	Pleasure	Other	Sum
Crude oil															
Oil products		3.12777e-05				0.000377965			5.65068e-06	7.64784e-09	3.26811e-05	1.13928e-06	5.28568e-06	6.52512e-05	0.000519258
Chemical															
Gas															
Container															
General cargo		0.00041714				0.00476995			7.19388e-05	9.14618e-08	0.000452178	1.40496e-05	6.40883e-05	0.00076741	0.00655684
Bulk															
Ro-Ro cargo															
Passenger		3.15084e-06				3.68038e-05			2.66887e-07	5.02168e-10	1.86393e-06	1.2693e-07	5.04204e-07	4.59141e-06	4.73085e-05
Fast ferry		1.85006e-08				2.80633e-07			9.61873e-10	1.16105e-11	3.31445e-07	1.65083e-08	1.92057e-08	6.52561e-08	7.32523e-07
Support		2.4357e-05				0.000290189			2.49159e-06	4.80211e-08	0.000130403	1.20193e-05	2.16908e-05	6.6937e-05	0.000548135
Fishing		2.11691e-06				2.55496e-05			3.17425e-07	1.85701e-08	2.14887e-05	7.63278e-05	1.62103e-05	9.61438e-06	0.000151644
Pleasure		1.19133e-05				0.000137326			1.86202e-06	1.0313e-08	4.12725e-05	1.62314e-05	1.51033e-05	2.61537e-05	0.000249872
Other		6.16225e-05				0.000706531			7.72974e-06	2.65624e-08	9.4732e-05	6.12156e-06	1.27807e-05	8.2762e-05	0.000972306
Sum		0.000551597				0.00634459			9.02581e-05	2.0309e-07	0.00077495	0.000126032	0.000135682	0.00102278	0.0090461

Charlie

Striking/Struck	Crude oil	Oil products	Chemical	Gas	Container	General cargo	Bulk	Ro-Ro cargo	Passenger	Fast ferry	Support	Fishing	Pleasure	Other	Sum
Crude oil	2.90542e-09	5.69047e-07	2.47083e-09	2.21347e-07	6.94328e-06	2.18595e-06	2.90563e-06	1.66329e-06	1.27117e-07	2.00703e-10	1.01344e-06	2.67595e-08	1.19342e-07	1.363e-06	1.71438e-05
Oil products	4.42914e-07	1.83358e-05	9.30364e-08	7.4355e-06	0.000222065	7.76627e-05	9.68128e-05	6.33978e-05	4.83326e-06	7.57027e-09	2.76809e-05	7.73541e-07	4.00335e-06	4.9579e-05	0.000573123
Chemical	1.5713e-09	8.02328e-08	3.8147e-12	3.6749e-08	9.8151e-07	3.37644e-07	4.11435e-07	3.14111e-07	2.23513e-08	6.74193e-14	2.27216e-08	3.30333e-10	1.01013e-08	1.81592e-07	2.40035e-06
Gas	1.56955e-07	6.61028e-06	4.01082e-08	2.41514e-06	7.34975e-05	2.96358e-05	3.27574e-05	2.4745e-05	1.74619e-06	5.34512e-10	3.80016e-06	1.12675e-07	1.23829e-06	2.00382e-05	0.000196794
Container	3.86602e-06	0.000153428	8.02406e-07	5.93092e-05	0.00172234	0.000655132	0.00081252	0.000484543	3.77322e-05	6.80269e-08	0.000280057	7.42605e-06	3.91292e-05	0.000444797	0.00470115
General cargo	1.9049e-06	8.5203e-05	4.19266e-07	3.56563e-05	0.00102789	0.000340955	0.000452265	0.000284997	2.15718e-05	2.41366e-08	9.87585e-05	2.78122e-06	1.59128e-05	0.000205397	0.00257373
Bulk	2.23131e-06	0.000105335	5.23012e-07	4.02385e-05	0.00116962	0.000431948	0.000443259	0.000342637	2.41561e-05	3.85344e-08	0.00018328	4.91135e-06	2.40806e-05	0.000286703	0.00305896
Ro-Ro cargo	1.01229e-06	4.8613e-05	2.84811e-07	2.15491e-05	0.000533184	0.000200805	0.000255029	0.000155267	1.32469e-05	6.06695e-09	2.94704e-05	8.26095e-07	8.69482e-06	0.000126892	0.00139488
Passenger	4.80677e-08	2.2581e-06	1.06374e-08	9.06401e-07	2.39543e-05	9.31238e-06	1.15992e-05	7.25531e-06	2.6041e-07	5.15817e-10	1.83247e-06	9.58921e-08	4.66109e-07	4.29291e-06	6.22927e-05
Fast ferry	5.55452e-10	1.21379e-08	2.78899e-13	8.9322e-10	1.42191e-07	4.77534e-08	7.75626e-08	8.71446e-09	6.80259e-10	7.6688e-12	2.07729e-07	1.07248e-08	1.22201e-08	3.89703e-08	5.6014e-07
Support	5.92635e-07	2.36221e-05	4.59809e-08	4.7358e-06	0.000268326	8.37765e-05	0.000123779	4.3451e-05	3.48787e-06	5.06928e-08	0.000117493	3.08114e-05	2.2325e-05	6.48297e-05	0.000787327
Fishing	5.47334e-08	2.1367e-06	1.36247e-07	2.58371e-07	2.64291e-05	7.32037e-05	1.10055e-05	2.87972e-06	3.24881e-07	1.58387e-08	4.12398e-05	4.66324e-05	1.29589e-05	8.21336e-06	0.000159471
Pleasure	2.3989e-07	1.03274e-05	3.70344e-08	3.09853e-06	0.000122074	3.86972e-05	5.18685e-05	2.79782e-05	2.15318e-06	1.01342e-08	4.04646e-05	1.235e-05	1.37812e-05	2.40205e-05	0.0003471
Other	9.58514e-07	3.93709e-05	1.28419e-07	1.51249e-06	0.000492391	0.000152248	0.000236886	0.000105554	6.46145e-06	2.42842e-08	7.31654e-05	3.73559e-06	8.45904e-06	6.29007e-05	0.00119741
Sum	1.15133e-05	0.000495901	2.38855e-06	0.000190987	0.00568983	0.00203006	0.00253118	0.00154469	0.000116124	2.46544e-07	0.000898485	0.000110494	0.000151191	0.00129925	0.0150723

Grounding Results

Alpha

Length	Crude oil	Oil products	Chemical	Gas	Container	General cargo	Bulk	Ro-Ro cargo	Passenger	Fast ferry	Support	Fishing	Pleasure	Other	Sum
0-25									7.22421e-07		0.0106877	0.000914317	0.00130539	5.14864e-05	0.0129596
25-50						2.31134e-05			9.74946e-06	6.59491e-06	0.00386223	0.00257865	0.00171494	0.00066207	0.00885735
50-75						6.477e-05				1.49597e-06	0.000416324	0.00644588	0.000840708	0.00164405	0.00941323
75-100						8.93688e-06			3.59704e-07		0.000834443		1.01093e-05	0.000235338	0.00108919
100-125		6.79897e-05				0.000271143					4.31849e-05			0.00280573	0.00318805
125-150		0.000332315				0.000261337					0.000563575		2.13682e-05	0.000705807	0.0018844
150-175		0.000934138				0.000493354			8.33161e-07		0.000218524			0.000242482	0.00188933
175-200		0.00202959				0.0222816			1.43554e-06		1.03411e-05			0.00020207	0.0245251
200-225		0.000338652				0.0240732			1.52778e-06		0.000786748			0.000231013	0.0254313
225-250	8.81668e-06					*0.072132*			8.45213e-07					0.00262381	0.0747654
250-275						0.00930925			7.19875e-06					0.000254815	0.00957126
275-300		0.00240245				0.0343149			5.31022e-05					0.000402699	0.0371731
300-325		0.00106744				0.0213541			2.3177e-06					6.9454e-06	0.0224308
325-350						0.0248628								6.74186e-05	0.0249303
350-375						0.0127288									0.0127288
375-400															
400-												0.00270718			0.00270718
Sum		0.00718139				0.222179			7.8092e-05	8.09089e-06	0.0174231	0.012646	0.00389252	0.0101358	0.273544

Bravo

Length	Crude oil	Oil products	Chemical	Gas	Container	General cargo	Bulk	Ro-Ro cargo	Passenger	Fast ferry	Support	Fishing	Pleasure	Other	Sum
0-25									7.22421e-07		0.0106877	0.000914312	0.00130538	5.14862e-05	0.0129596
25-50						2.31134e-05			9.74946e-06	6.59491e-06	0.00386223	0.00257865	0.00171493	0.000662066	0.00885733
50-75						6.47558e-05				1.49597e-06	0.000416321	0.00644588	0.000840708	0.00164391	0.00941308
75-100						8.93688e-06			3.59704e-07		0.000834436		1.0105e-05	0.000235308	0.00108915
100-125		6.79582e-05				0.000271057					4.31849e-05			0.00280573	0.00318793
125-150		0.000332189				0.000261193					0.000563575		2.13682e-05	0.000705725	0.00188405
150-175		0.00093408				0.000493142			8.33161e-07		0.000218524			0.000242471	0.00188905
175-200		0.00202943				0.0222807			1.43553e-06		1.03411e-05			0.000202017	0.0245239
200-225		0.000338642				0.0240728			1.5268e-06		0.000786687			0.000231029	0.0254307
225-250	8.81361e-06					*0.0721306*			8.45213e-07					0.0026237	0.0747639
250-275						0.00930893			7.19856e-06					0.000254805	0.00957093
275-300		0.00240237				0.0343141			5.31016e-05					0.000402684	0.0371723
300-325		0.00106739				0.0213539			2.3177e-06					6.94526e-06	0.0224305
325-350						0.0248625								6.74122e-05	0.0249299
350-375						0.0127285									0.0127285
375-400															
400-												0.00270718			0.00270718
Sum		0.00718087				0.222174			7.80902e-05	8.09089e-06	0.017423	0.012646	0.0038925	0.0101353	0.273538

Charlie

Length	Crude oil	Oil products	Chemical	Gas	Container	General cargo	Bulk	Ro-Ro cargo	Passenger	Fast ferry	Support	Fishing	Pleasure	Other	Sum
0-25									7.11125e-07		0.0153143	0.00196468	0.00137859	0.000153461	0.0188118
25-50						1.25531e-05	0.00208181		3.81145e-06	2.44357e-06	0.00656818	0.00174044	0.00193632	0.000230254	0.0125758
50-75		4.35459e-05				0.00020743			2.34644e-07	1.71013e-06	0.00377209	0.00338009	0.000594896	0.00114683	0.00914682
75-100						7.23341e-06			4.18846e-07		0.000530177		1.60844e-06	0.000380108	0.000934022
100-125	2.76469e-05	8.84181e-05		3.40165e-06		0.000333142	3.81892e-05				0.000157155			0.00219529	0.00284325
125-150		0.00045348	3.8236e-06			0.000258258	8.21445e-05				2.88801e-06		2.59132e-05	0.000312874	0.00116538
150-175		0.000824652		0.000135674		0.000337743	0.000249912	1.61712e-06	5.73506e-07		6.17579e-06			0.000149641	0.00170599
175-200	9.79965e-06	0.00211869		2.09527e-05	0.00276961	0.00124865	0.00697657	8.94289e-05	1.35912e-06		1.37757e-06			0.00016333	0.0133998
200-225					0.00101627	0.00249122	0.0110739	0.000203429	1.67264e-06					0.000432494	0.015219
225-250		8.52689e-05				0.00890269	*0.0537591*	6.74192e-05						0.00170379	0.0680512
250-275					0.00600215	0.00227335	0.000161319	0.000661426	8.25068e-06					9.87797e-05	0.00920528
275-300		0.000330014		0.00129908	0.01594	0.00654615	0.00448375		4.36884e-05					6.51979e-05	0.0287078
300-325		0.000593889		4.5472e-05	0.0129187	0.00393788	0.000145252		2.36178e-06					0.000386358	0.0180099
325-350					0.0186011	0.00130347	0.00041221							3.72121e-06	0.0203205
350-375					0.00529565	0.00470235									0.00999801
375-400															
400-															
Sum	3.74466e-05	0.00453797	3.8236e-06	0.00150458	0.0660753	0.0305621	0.0794642	0.00102332	6.40739e-05	4.1537e-06	0.0263783	0.00708521	0.00395181	0.00740212	0.228094

Allision Results

Bravo

Length	Crude oil	Oil products	Chemical	Gas	Container	General cargo	Bulk	Ro-Ro cargo	Passenger	Fast ferry	Support	Fishing	Pleasure	Other	Sum
0-25									1.9903e-09		1.47964e-05	4.52596e-05	0.000119447	4.16704e-06	0.000183672
25-50						1.27869e-07			3.99396e-08	1.3744e-08	1.9579e-05	1.30678e-05	1.83743e-05	4.41936e-05	9.53962e-05
50-75						6.31824e-06				1.00729e-11	8.71969e-06	7.27472e-06	3.61033e-06	0.000324513	0.000350435
75-100						6.551e-08			3.31159e-08		7.25701e-06		9.42341e-06	0.000117612	0.000134391
100-125		3.85904e-05				7.30523e-05					5.79054e-08			8.79059e-05	0.000199606
125-150		0.000223454				0.000212987					5.51775e-07		1.02559e-09	0.000141236	0.00057823
150-175		8.89463e-05				0.000322432			5.3358e-09		1.46078e-06			2.11837e-05	0.000434028
175-200		0.000183353				0.00199902			5.00503e-07		2.05121e-08			0.000137029	0.00231992
200-225		1.98537e-05				0.00121595			1.9398e-07			4.70912e-06		0.000167009	0.00140772
225-250		2.8542e-06				0.00243051			4.09076e-09					0.000255519	0.00268889
250-275						0.000974814			2.07747e-06					2.32548e-05	0.00100015
275-300		0.000295056				0.00170862			6.60031e-07					5.16804e-06	0.0020095
300-325		3.07281e-05				0.00173534			1.51361e-08					7.7354e-06	0.00177382
325-350						0.00185744								1.37975e-05	0.00187124
350-375						0.00110747									0.00110747
375-400															
400-												2.481e-08			2.481e-08
Sum		0.000882836				0.0136441			3.53159e-06	1.3754e-08	5.71522e-05	6.56269e-05	0.000150856	0.00135032	0.0161545

Charlie

Length	Crude oil	Oil products	Chemical	Gas	Container	General cargo	Bulk	Ro-Ro cargo	Passenger	Fast ferry	Support	Fishing	Pleasure	Other	Sum
0-25									3.38135e-09		8.56966e-06	1.73785e-05	9.41101e-05	3.95289e-06	0.000124015
25-50						9.83298e-08	1.19594e-05		3.33588e-08	8.96652e-09	4.2177e-05	7.14298e-06	2.57155e-05	4.87213e-05	0.000135857
50-75		2.23054e-08				4.26856e-06			1.68753e-09	1.08779e-11	5.97319e-05	9.61018e-06	2.90869e-06	0.000234168	0.000310711
75-100						6.69721e-08			3.605e-08		1.61236e-05		3.29768e-08	1.05351e-05	2.67946e-05
100-125	4.10957e-06	3.12586e-06		1.6763e-06		0.000106194	6.79581e-05				1.61645e-05			2.69832e-05	0.000226212
125-150		0.000138922	2.63802e-06			0.000122699	1.66196e-05				1.74807e-05		1.02559e-09	0.000126909	0.000425269
150-175		5.37534e-05		1.4367e-05		0.00020881	0.000103806	1.3117e-05	8.33793e-09		6.97092e-08			0.000110142	0.000504073
175-200	1.79872e-08	0.000184487		9.82789e-07	0.000197052	0.000545622	0.000495642	0.00031919	5.52396e-07		1.14909e-08			0.000135449	0.00187901
200-225					2.18011e-05	0.000236285	0.000151485	0.000665257	2.06348e-07					0.000151144	0.00122618
225-250		6.71428e-06			0.000169097	0.000266473	0.00102835	0.000261578	5.91773e-09					9.8136e-05	0.00183035
250-275					0.000521967	7.99876e-05	1.17546e-05	5.59997e-05	2.10282e-06					3.68077e-05	0.000708619
275-300		1.08379e-05		0.000130415	0.00103332	0.000436155	0.000284192		9.7731e-07					2.36759e-05	0.00191958
300-325		4.59233e-05		1.66481e-06	0.000841729	0.000211769	4.90845e-06		2.4005e-08					3.11937e-05	0.00113721
325-350					0.000930258	2.5331e-05	1.15123e-05							6.41874e-06	0.00097352
350-375					0.000256239	0.000211481									0.000467721
375-400															
400-															
Sum	4.12756e-06	0.000443785	2.63802e-06	0.000149106	0.00397147	0.00245524	0.00218819	0.00131514	3.95161e-06	8.9774e-09	0.000160329	3.41317e-05	0.000122768	0.00104424	0.0118951