

**Ports and Waterways Safety Assessment
Workshop Report**

**Charleston, South Carolina
11-12 February 2026**



**Providing Navigation Safety Information
for America's Waterways Users**

**Released By:
CAPT Margaret Kennedy
Commanding Officer
U.S. Coast Guard Navigation Center**

The views and opinions expressed in Chapter 2, Section B-E, and Appendix C-F of this report are those of the participants and do not reflect the official view or position of the United States Coast Guard. This information is a posting for the public's information alone and the Coast Guard does not endorse this information or anything on it. The USCG disclaims responsibility and liability for the information, its messaging, and its content.

Executive Summary

Coast Guard Sector Charleston sponsored a Ports and Waterways Safety Assessment (PAWSA) workshop in Charleston, South Carolina, from February 11, 2026, to February 12, 2026. Twenty-seven participants and observers representing a range of waterway users, stakeholders, and federal, state, and local regulatory and public safety authorities met and collaboratively assessed navigational safety on the waterways adjoining the port of Charleston. This report provides a visual depiction of the study area and contains the full list of workshop participants and their associated organizations. The first day of the workshop included discussions about port and waterway attributes and vessel traffic in relation to the sixteen Waterway Risk Factors (WRFs) in the PAWSA Waterway Risk Model, which is described in more detail in this report. During this dialogue, participants identified specific port WRF issues to inform mitigations and facilitate the Focused Quantitative Risk Assessment (FQRA) conducted on the second day of the workshop. At the conclusion of WRF discussions, Risk Characterization for each WRF was established based on participants' survey responses. Risk Characterization assesses the potential consequence, risk trend, risk tolerance, and effectiveness of existing mitigation strategies for a specific WRF. The metrics from the Risk Characterization quantitatively prioritized WRFs to inform discussions during the next phase of the workshop. During the second day, participants conducted a FQRA to approximate adverse economic impacts of prioritized WRF issues and engaged in follow-on discussions to identify and develop risk mitigation strategies. The output of the FQRA is called a Risk Index Number (RIN), a numerical value designed to quantify an issue's adverse monetary impact on a port to guide resource prioritization and decision-making. A value of one RIN is equivalent to one million dollars in economic loss to a port. A higher RIN value is indicative of larger projected annual economic loss due to a specific event type or issue. FQRA results for the average annual frequency for each type of event and its associated RIN Value for the workshop study area is provided in the table below.

Event Name	RIN	Avg Frequency
Collision	29.42	7.78
Traffic Restricted	14.29	25.93
Allision	13.74	12.18
Sinking	10.38	2.51
Grounding	2.36	7.85
Infrastructure Failure	1.32	1.17
Oil Spill	0.91	1.75
Fire/Explosion	0.55	0.17
HAZMAT Release	0.26	0.50
Total	73.21	59.83

FQRA results for the five issues with the highest RIN value and the associated numerical value are presented in Chapter 2.C. The RIN results, recommended mitigation strategies, and participant observations documented in this report will meaningfully facilitate continued collaboration between the Coast Guard and waterway stakeholders to improve safe and efficient navigation within the Marine Transportation System (MTS). The Director of Marine Transportation Systems (CG-5PW), the Coast Guard's Navigation Center (CG NAVCEN), and CG Sector Charleston extend their sincere appreciation to participants for their contributions to the Charleston PAWSA workshop.

TABLE OF CONTENTS

CHAPTER 1. GENERAL

A. Background and Purpose	1
B. Methodology	2

CHAPTER 2. CHARLESTON PAWSA WORKSHOP

A. PAWSA Study Area	10
B. Participant Validation of WRF Prioritization	11
C. Risk Index Number Results	13
D. Risk Mitigation Strategies	17

Appendix List

Appendix A. Workshop Participants	
Appendix B. Waterway Risk Model Terms and Definitions	
Appendix C. Participant Comments	
Appendix D. Geospatial Participant Comments	
Appendix E. Waterway Risk Factor Issues	
Appendix F. National and Local Event and Consequence Data	

CHAPTER 1. GENERAL

A. Background and Purpose

1. The Director of Marine Transportation Systems (CG-5PW) is responsible for developing and implementing policies and procedures that facilitate commerce, improve safety and efficiency, and maximize the commercial viability of the Marine Transportation System (MTS). In the late 1990s, the Coast Guard convened a national dialogue group (NDG) comprised of maritime stakeholders to identify the needs of waterway users with respect to Vessel Traffic Management (VTM) and Vessel Traffic Service (VTS) systems. A major outcome of the NDG was the development of the Ports and Waterways Safety Assessment (PAWSA) process, which the Coast Guard established as the formal model for facilitating stakeholder discussion to identify VTM improvements and determine candidate VTS waterways. The PAWSA methodology has been modernized several times by the CG NAVCEN and Office of Waterways & Ocean Policy (CG-WWM) since its original inception for purposes of creating a more adaptable tool available to Sector Commanders to engage the maritime community to monitor and improve the health of the MTS within their area of responsibility. The most recent PAWSA process update occurred in 2025.
2. The current PAWSA process convenes a select group of waterway users and stakeholders to facilitate a structured workshop agenda to meet pre-identified risk assessment objectives. A successful workshop involves the participation of professional waterway users with local expertise in navigation, waterway conditions, and port safety. Stakeholder involvement is central to ensuring that important environmental, public safety, and economic consequences receive appropriate attention as risk interventions are identified and evaluated. The workshop culminates in a written report that includes proposed risk mitigations developed by participants, which is made publicly available on the CG NAVCEN's website (<https://www.navcen.uscg.gov/ports-and-waterways-safety-assessment-final-reports>.)
3. The PAWSA process strives to achieve the following objectives:
 - a. Gather stakeholder input to identify major waterway trends, safety hazards, and potential mitigation strategies.
 - b. Bolster public-private partnership and enhance cooperation across the MTS.
 - c. Generate a stakeholder driven report that captures data gathered from the PAWSA to prioritize future projects impacting the MTS.

B. Methodology

1. Waterway Risk Conditions and Waterway Risk Factors. The PAWSA process is designed to convert qualitative experience, observations, and opinions of participants into quantitative assessments. This method uses numerical comparison among sixteen WRFs to build consensus among participants to better inform conversations regarding risk mitigation strategies within an identified study area. The Waterway Risk Condition categories and associated WRFs are listed in Table 1 and further defined in Appendix B.

Navigation	Vessel Quality & Operation	Traffic	Waterway
Winds	Large Commercial Vessels	Volume of Commercial Traffic	Dimensions
Currents and Tides	Small Commercial Vessels	Volume of Recreational Traffic	Obstructions
Visibility Restrictions	Commercial Fishing Vessels	Waterway Use	Visibility Impediments
Bottom Type	Recreational Vessels	Congestion	Configuration

Table 1 – The four Waterway Risk Condition categories and sixteen WRFs.

2. PAWSA Workshop Structure. Each PAWSA workshop is a two-day facilitated process. The following sections detail the structure and goals for each day of a workshop. A maximum of 30 stakeholders divided into 15 two-person teams may participate.

- a. PAWSA Workshop - Day 1.

- (1) WRF Discussion. During the first day of a PAWSA, participants gain a comprehensive understanding of the workshop study area and are led through individual discussions for each WRF identified in Table 1. The purpose of these discussions is to provide a collaborative forum for stakeholders to generate a list of specific challenges unique to their respective port as related to each WRF. Participants identify and prioritize the top three issues for each WRF to facilitate

the Focused Quantitative Risk Assessment (FQRA) process and inform mitigation discussions during Day 2. These issues are documented in Appendix E.

(2) Risk Characterization Survey. Risk Characterization is a combined qualitative measure of the risk tolerance, risk trend, and effectiveness of existing mitigation strategies for a specific WRF. Surveys are completed at the end of Day 1 by the established two-person teams. The survey asks teams to evaluate the Current Risk Level, Current Risk Trend, and Current Risk Mitigations to characterize the risk associated with each WRF. Participants select from a set of qualitative descriptors that have weighted numeric values assigned to each answer to calculate Risk Characterization. Table 2 provides the available selections for each Risk Characterization question.

	Available Selections
Current Risk Level	We could accept more risk
	Balanced
	Unacceptable
Current Risk Trend	Decreasing
	Steady
	Increasing
Current Risk Mitigations	Acceptable
	Acceptable, but tenuous
	Unacceptable <i>*(If unacceptable select all that apply)</i>
	<i>Not Effective</i>
	<i>Too costly</i>
	<i>Slow operations</i>
	<i>Causes other issues</i>

Table 2 – WRF Survey, Risk Characterization categories.

After each team completes the Risk Characterization survey, their assessment of the Waterway Risk Factors is compiled into a Characterization Count. The Characterization Count is crucial because it reflects how each team perceives risk for each WRF. The selected values from the survey generate a color-coded classification that informs the overall WRF Risk Characterization for each team. The results from each team survey are then aggregated together to determine the Characterization Rating for each WRF that represents the average of the stakeholder group. The Characterization Rating informs the prioritization of

WRFs to guide mitigation development discussions and evaluation of WRF issues through the FQRA during Day 2 of the workshop.

(3) Characterization Count Color Designations. Individual team Characterization Count for a WRF is designated as red, orange, or green. For this scale, red represents high risk, orange represents intermediate risk, and green represents low risk. The following subsections outline the thresholds for each color-coded Risk Characterization designation for team Characterization Count.

(a) A WRF is designated with a red Risk Characterization when an individual team determines the WRF Current Risk Level is “unacceptable,” or the Current Risk Mitigations are “unacceptable.”

(b) A WRF is designated with an orange Risk Characterization when an individual team determines the Current Risk Trend is “increasing” and the Current Risk Mitigations are “weak.”

(c) A WRF is designated with a green Risk Characterization when an individual team’s combinations of answers do not meet the threshold for red or orange.

(4) Characterization Rating Color Designations. When the teams complete the Risk Characterization survey, their assessments are combined to calculate and assign the overall Characterization Rating for each WRF, as shown as an example in Table 3.

Category	RF Small	Characterization	Red	Orange	Yellow	Green
Traffic	Rec	Red	10	3		1
Vessel	Rec	Red	11	1		2
Vessel	Small	Red	9	3		2
Traffic	Congestion	Orange	6	6		2
Traffic	Usage	Orange	4	8		2
Navigational	Bottom	Green	1	1		12
Navigational	Tides	Green	2	4		8
Navigational	Vis	Green	1			13
Navigational	Winds	Green		1		13
Traffic	Commercial	Green		5		9
Vessel	Fishing	Green	1			13
Vessel	Large	Green	2	4		8
Waterway	Config	Green	4	2		8
Waterway	Dims	Green	4	2		8
Waterway	Obstr	Green	2	1		11
Waterway	Vis	Green	4	2		8

Characterization Count - Individual Team
Red. The Risk Level is Unacceptable OR the Mitigations are Unacceptable.
Orange. The Risk Trend is Increasing AND the Mitigations are Weak.
Green. All others.

Characterization Rating - Overall
Red. 60% or more teams rated as Red.
Orange. 50% or more teams rated Orange or higher.
Green. 50% or more teams rated as Green.

Table 3 – Example Risk Characterization survey results.

Characterization Rating for a WRF is designated as red, orange, or green. The color-coded scale for the Characterization Rating is the same as Characterization Count, but the thresholds for attributing the color designation are different. In Table 3, the numbers below each of the header columns labeled red, orange, and green represent the number of individual teams that attribute a certain risk level to that specific WRF. The Characterization Rating for a WRF is determined by plurality. The following subsections outline the thresholds for each color-coded Risk Characterization Rating designation.

- (a) A WRF is designated with a red Characterization Rating if 60% or more of the teams select that specific rating.
- (b) A WRF is designated with an orange Characterization Rating if 50% or more of the teams select that specific rating.
- (c) A WRF is designated a green Characterization Rating if 50% or more of the teams select that specific rating.

(5) At the conclusion of Day 1, PAWSA facilitators present the Risk Characterization survey results and facilitate discussion among participants to determine and validate prioritization of WRFs for use in the FQRA and mitigation development.

b. PAWSA Workshop – Day 2. The second day of the workshop is focused on fulfilling two objectives. The first is to complete the FQRA to calculate the Risk Index Number (RIN) for the highest prioritized WRFs identified during Day 1. The second is to develop mitigations for issues associated with those WRFs. The following subsections provide more detail regarding the process and methodology for executing the FQRA and WRF mitigation development.

(1) Focused Quantitative Risk Assessment (FQRA). The FQRA is a process to conduct a normalized comparison between historical data and participant expertise to approximate the yearly adverse economic impact of individual WRFs on a port. The output from this calculation is called the RIN. The value of the RIN represents the annual average potential economic loss in millions of dollars based on the associated WRF. The FQRA uses existing historical data from Coast Guard vessel operational controls, waterways management operational controls, and incident investigation activities documented in the Coast Guard's Maritime Information for Safety and Law Enforcement (MISLE) database. The MISLE database is the centralized repository for capturing and reporting the information required to support Coast Guard marine safety, security, environmental protection,

and law enforcement programs and for ensuring compliance with statutory and regulatory record keeping requirements. The FQRA is a two-pronged method derived from combining the distribution of historical outcomes for a local area and the multiplication product of the likelihood and consequence for a specific scenario. Figure 1 depicts a flow chart that visually represents the process used in the FQRA.

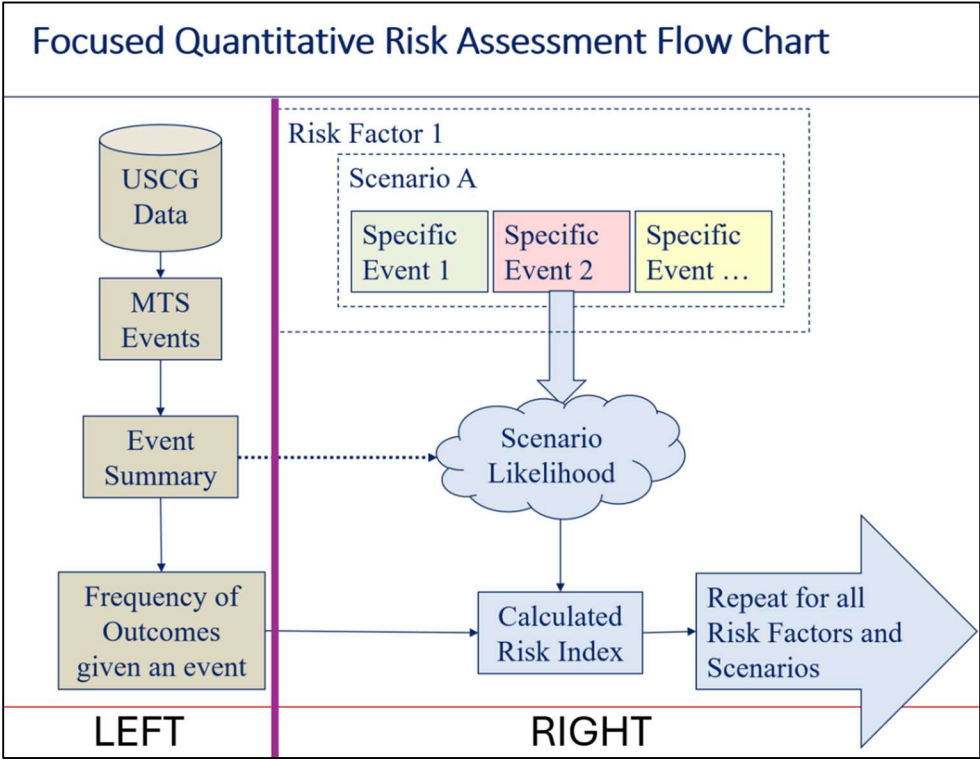


Figure 1 – FQRA Flow Chart.

- (a) During the first step of the FQRA, represented on the left side of Figure 1, Coast Guard MISLE data is synthesized to determine the historical frequency of events and their outcomes. The outputs from this first step guide the calculations used in the second step to convert qualitative stakeholder input into a quantitative metric. In this model, outcomes are unwanted consequences that are classified as safety, environmental, or economic. For more information on the Coast Guard established consequence types, severity categories, and fiscal equivalence, please see Table 1 in section B.1 of Appendix B.
- (b) During the second step of the FQRA, represented on the right side of Figure 1, participants provide qualitative data regarding the types and likelihood of an event occurring due to the issues identified for the top prioritized WRFs on

Day 1 of the workshop. To gather this information, facilitators provide participant teams with a Risk Event Form pre-populated with the prioritized WRFs and the associated top three issues for each factor that were determined during Day 1. The stakeholders use their local anecdotal knowledge of historical events to assign each issue up to three types of events that may occur due to the issue and the predicted frequency of the event. Available types of events on the Risk Event Form include allision, collision, fire/explosion, grounding, oil spill, sinking, or traffic restricted. For definitions of these event types, please see Appendix F. After selecting an event type, participants designate a predicted likelihood of the event, based on local knowledge and experience. Likelihood is the probability of an event based on local historical trends. Frequency thresholds for the likelihood designations used in the FQRA to calculate RIN are described in Table 4. The model standardizes the likelihood with incidents per fifty years to allow for easier understanding and comparison with historical numbers. The corresponding probability of each event is multiplied by the consequence value and normalized to millions of dollars, estimating the RIN to one million dollars in economic loss for an associated event.

Likelihood	Frequency	Probability
Very Unlikely	Once or twice in the history of the port / waterway	0.00055
Rare	Once every 50-100 years	0.006
Occasional	Once or twice every 10-20 years (2-20 every 50 years)	0.22
Probable	Once or twice every year or two (25-75 in 50 years)	1
Frequent	More than twice per year (100 in 50 years)	5

Table 4 – Likelihood designations, frequency thresholds, and probability values used to calculate RIN.

- (c) The model uses MISLE data, including vessel operational controls, waterways management operational controls and incident investigation activities, to group historical investigations into consequence categories. This allows normalization of stakeholder inputs using historical data. It is important to note that the data used in this model was selected for its quality and availability and is therefore limited. It does not include reports or data from all types of events reported or investigated by the Coast Guard. The historically synthesized national and local data is used to pre-assign specific values for

stakeholder qualitative input and create the frequency distribution used in the RIN calculation. During the FQRA, both the historical national events and local events are provided to stakeholders for review in handout form, prior to conducting the assessment. Please see Appendix F for the national and local event data provided to stakeholders during the PAWSA.

(d) For the FQRA, the stakeholders select a frequency for each event, which is then multiplied by the distribution of consequences. This is added together to calculate the RIN.

(2) FQRA Results. Facilitators use the qualitative data collected in the Risk Event Forms to conduct the FQRA. This generates a RIN and estimated annual frequency for each event type, which are sortable by WRF and issue. Table 5 and 6 provide examples of RIN results and data from the FQRA. A large volume of raw data is generated from the FQRA. To keep the report concise, only RIN results for all event types and the five issues with the highest RIN values are presented in this report and can be found in Chapter 2, Section C.3. Additional raw FQRA data, including the RIN results for all evaluated issues and associated event types, is available by request from the Coast Guard Navigation Center.

(a) The results summarized in Table 5 provide an example of the RIN and annual frequency for each event type as determined through the FQRA. The RIN represents a monetary quantification of identified risks. For the purposes of this assessment, a RIN value of '1' corresponds to a potential financial impact of \$1 million (e.g., 2.5 RIN = \$2.5 million). This quantification provides essential context for assessing the potential financial impact on the maritime system during an event.

Event Name	RIN	Avg Frequency
Collision	10.16	2.69
Traffic Restricted	7.72	14.01
Sinking	6.61	1.60
Infrastructure Failure	5.83	5.17
Allision	4.43	3.93
Grounding	1.08	3.60
Oil Spill	0.22	0.43
HAZMAT Release	0.04	0.08
Fire/Explosion	0.01	0.00
Total	36.11	31.52

Table 5 – Example RIN and annual frequency results by event.

(b) The results summarized in Table 6 provide an example of RIN values broken down by WRF, issue, and event type. Stakeholders can leverage the RIN to compare the costs associated with implementing mitigation measures against the potential cost of an incident and its subsequent cascading effects, thereby optimizing resource allocation for risk reduction. For example, in Table 6, if stakeholders reported that "Groundings throughout the study area can cause the waterway to shut down for an extensive amount of time," and associate a RIN of 1.02, this indicates that the issue is estimated to cost the local maritime system \$1,020,000.

Risk_Factor	RIN	Avg Events
Bottom Type	6.52	8.69
Groundings throughout the study area can cause the waterway to shut down for an extensive amount of time.	1.02	1.76
Allision	0.09	0.08
Collision	0.00	0.00
Grounding	0.05	0.17
HAZMAT Release	0.00	0.00
Infrastructure Failure	0.10	0.08
Oil Spill	0.09	0.17
Sinking	0.00	0.00
Traffic Restricted	0.69	1.25

Table 6 – Example RIN by WRF, issue, and event type.

(c) Normalizing the impact value in dollars provides the ability to update and localize the model as needed or desired. This enables comparison between past and current results of the same port and comparisons between different ports. Port specific results generated during a workshop can be compared to existing Coast Guard data of historical events to highlight local mariner knowledge of events captured through the RIN process. Chapter 2, Section C.3. contains participant issues with the top five RIN values extracted from the FQRA results.

(3) **Mitigations.** Following completion of the FQRA, facilitators present the Risk Characterization survey results and facilitate discussion among participants to determine prioritization of WRF for mitigation development. Stakeholders collaboratively determine the top WRFs to focus dialogue for mitigation development during the remainder of the workshop. The development of mitigation strategies is guided by facilitators using the key issues identified during discussions from Day 1. These issues are used as the starting point for participants to brainstorm mitigations to address concerns and are the same issues used in the FQRA. Facilitators assist participants in developing risk mitigation strategies that are both impactful and feasible, ideally capturing those that are well-developed

proposals with clear delineation of ownership and predicted timelines to enact change. Through this invaluable process, stakeholders make recommendations to improve safe and efficient waterways usage within the port study area, creating a comprehensive list of action items for future implementation or reevaluation.

CHAPTER 2. CHARLESTON PAWSA WORKSHOP

A. PAWSA Study Area

1. The geographical area for the Charleston PAWSA included Charleston Harbor and the convergence of the Wando, Cooper, and Ashley Rivers as depicted by the quadrilateral polygon in Figure 2. The coordinates of the northwest point of this polygon are 32.858°N, 079.952°W and the coordinates of the southeast point are 32.417°N, 079.325°W. Graphic representations of this study area were used to facilitate discussion with participants. Additionally, geographically referenced comments were collected during the workshop and are documented as chartlets in Appendix D.

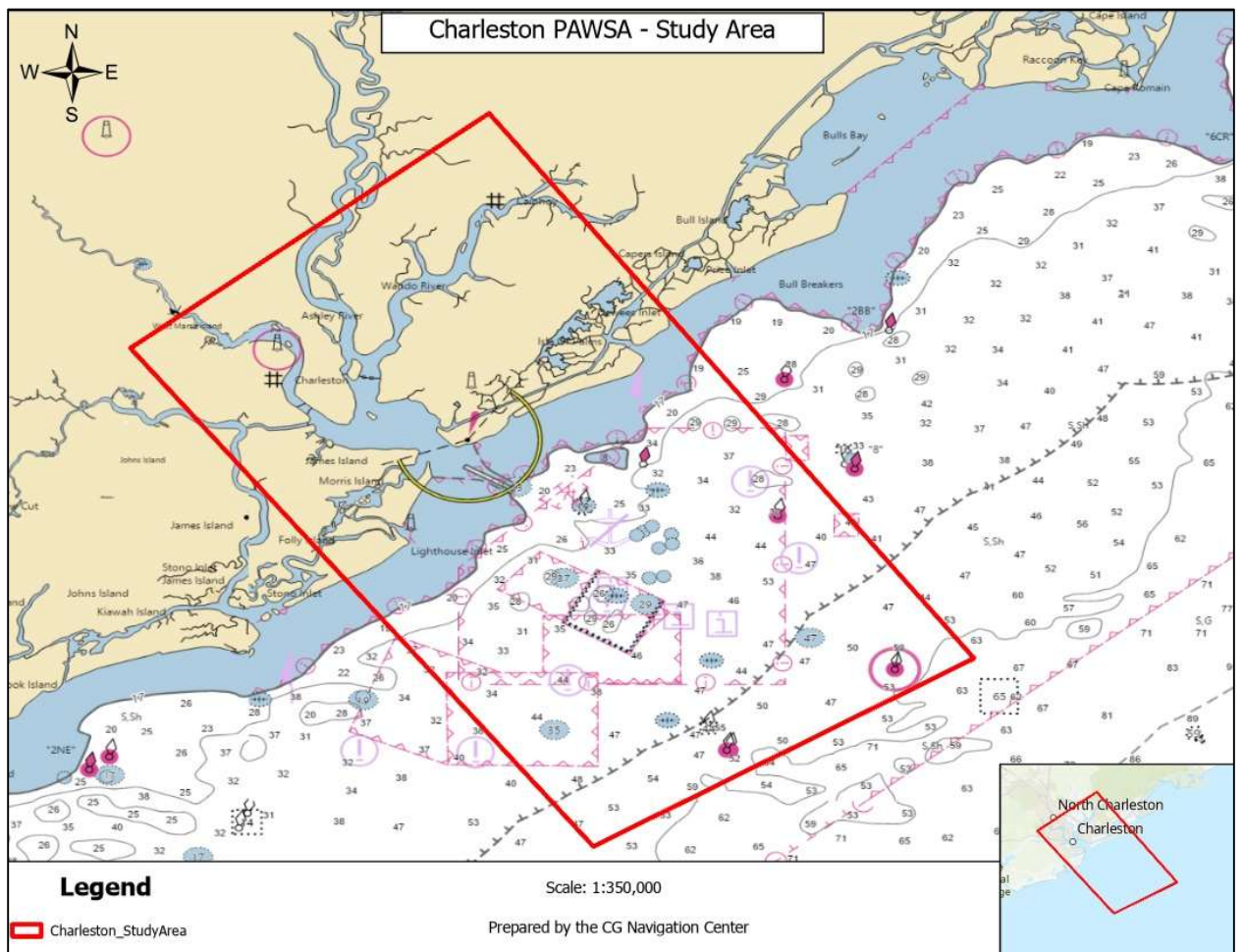


Figure 2 - Charleston PAWSA workshop study area.

B. Participant Validation of WRF Prioritization.

1. The Risk Characterization survey results are depicted below in Figure 3. The results are grouped by Risk Characterization. These results were presented to participants to validate the prioritization order of WRFs to facilitate the FQRA and for mitigation strategy development.
2. The Risk Characterization results indicated a generally high level of existing risk within the Charleston PAWSA study area. The specific WRFs characterized with unacceptable risk include recreational vessel quality, commercial fishing vessel quality, traffic congestion, and waterway dimensions. Although ongoing expansion of deepwater projects address the port of Charleston’s physical capacity, high risk in vessel quality and traffic WRFs is primarily attributed to human-centric challenges. Lowering risk in these WRFs requires more targeted educational outreach and inter-agency coordination aimed at preventing minor safety lapses from escalating into more consequential maritime casualties.

Category	RF Small	Characterization	Red	Orange	Yellow	Green
Traffic	Rec	Red	6	2		
Vessel	Fishing	Red	6			2
Vessel	Rec	Red	7			1
Traffic	Congestion	Orange	1	7		
Traffic	Usage	Orange	2	4		2
Vessel	Large	Orange		4		4
Navigational	Bottom	Green		1		7
Navigational	Tides	Green	1	1		6
Navigational	Vis	Green		1		7
Navigational	Winds	Green	1	1		6
Traffic	Commercial	Green				8
Vessel	Small	Green	1	2		5
Waterway	Config	Green		3		5
Waterway	Dims	Green		2		6
Waterway	Obstr	Green	2	1		5
Waterway	Vis	Green		3		5

Characterization Count - Individual Team
Red. The Risk Level is Unacceptable OR the Mitigations are Unacceptable.
Orange. The Risk Trend is Increasing AND the Mitigations are Weak.
Green. All others.

Characterization Rating - Overall
Red. 60% or more teams rated as Red.
Orange. 50% or more teams rated Yellow or higher.
Green. 50% or more teams rated as Green.

Figure 3 - Risk Characterization survey results for all WRFs.

3. The Risk Characterization survey results determined the ranking of WRFs according to participant evaluation. Table 7 presents WRFs in descending priority order from high to low. Following subjective evaluation, participants selected tides and currents and obstructions, in addition to orange and red WRFs, as the most significant WRFs that contributed to potential incidents within the Charleston PAWSA study area.

Waterway Risk Category	WRF
Traffic	Volume of Recreational Traffic
Vessel Quality & Operation	Commercial Fishing Vessels
Vessel Quality & Operation	Recreational Vessels
Traffic	Congestion
Waterway	Dimensions
Vessel Quality & Operation	Large Commercial
Navigational	Tides & Currents
Waterway	Obstructions

Table 7 - Validated and prioritized WRFs listed from high to low.

C. Risk Index Number Results

1. RIN Results by Frequency. As detailed in Table 7, participants validated and prioritized WRFs within the Charleston PAWSA study area. Based on this prioritization, stakeholders completed Risk Event Forms (as described in Chapter 1.B.2.b.(1)(b)) for the top eight WRFs. Each form captured the top three validated issues that stakeholders deemed most pertinent for each of the eight highest prioritized WRFs. Appendix E contains a full list of these participant-presented and validated issues. The issues presented in this appendix are edited for clarity and syntax.
2. The average annual frequency for each type of event with its associated RIN value is listed from highest to lowest in Table 8.

Event Name	RIN	Avg Frequency
Collision	29.42	7.78
Traffic Restricted	14.29	25.93
Allision	13.74	12.18
Sinking	10.38	2.51
Grounding	2.36	7.85
Infrastructure Failure	1.32	1.17
Oil Spill	0.91	1.75
Fire/Explosion	0.55	0.17
HAZMAT Release	0.26	0.50
Total	73.21	59.83

Table 8- RIN by event type

3. RIN Results by Issue. The five issues with the highest RIN values as identified from stakeholder surveys completed during Day 2 of the PAWSA workshop are ordered from highest to lowest in Table 9. The verbiage for the issues in Table 9 is presented as agreed upon and used by participants during the FQRA. No changes were made to this wording following the conclusion of the workshop. Additional data and information for the Sector Charleston RIN results is available by request from the Coast Guard Navigation Center.

Issue #1	The current licensing requirements for recreational vessels are not adequate in ensuring proper knowledge of Navigation Rules, knowledge of the waterway, or boating safety practices creating unsafe vessel operations.			
Event Type	RIN	Event Type	RIN	Total RIN
Allision	1.60	Infrastructure Failure	0	12.22
Collision	5.68	Oil Spill	0.26	
Fire/Explosion	0	Sinking	3.79	
Grounding	0.60	Traffic Restricted	0.55	
Issue #2	Boat clubs and rental companies do not require a boating license and provide no boating education prior to a customer's rental resulting in untrained, inexperienced operators and unsafe conditions within the waterway.			
Event Type	RIN	Event Type	RIN	Total RIN
Allision	1.60	Infrastructure Failure	0	10.65
Collision	5.67	Oil Spill	0	
Fire/Explosion	0	Sinking	2.07	
Grounding	0.58	Traffic Restricted	0.73	
Issue #3	The Wappoo Creek Bridge operating restrictions, half hour opening for recreational vessels and on demand for tugs with tows, is an ineffective process to manage extensive traffic congestion in the channel without consideration for safe transit times.			
Event Type	RIN	Event Type	RIN	Total RIN
Allision	1.13	Infrastructure Failure	0.66	4.92
Collision	2.21	Oil Spill	0	
Fire/Explosion	0	Sinking	0	
Grounding	0.15	Traffic Restricted	0.78	
Issue #4	The lack of recreational vessel operator knowledge of safe areas to operate and the volume of recreational traffic in commercial vessel transit areas causes an increase of recreational mariners impeding commercial traffic.			
Event Type	RIN	Event Type	RIN	Total RIN
Allision	0.56	Infrastructure Failure	0	4.84
Collision	2.84	Oil Spill	0	
Fire/Explosion	0	Sinking	0	
Grounding	0.05	Traffic Restricted	1.38	
Issue #5	The silt wall at Federal Law Enforcement Training Center Charleston, though not in the channel, impedes navigable waters resulting in multiple casualties.			
Event Type	RIN	Event Type	RIN	Total RIN
Allision	1.41	Infrastructure Failure	0	4.83
Collision	0.32	Oil Spill	0.22	
Fire/Explosion	0	Sinking	2.76	
Grounding	0.13	Traffic Restricted	0	

Table 9 – Highest five RIN values ranked by issue in descending order.

4. Summary of RIN Results. The data indicates that Collisions have the highest RIN. In the Charleston PAWSA study area, this concern is amplified by stakeholder observations regarding high recreational vessel traffic and a lack of licensing requirements resulting in a lack of navigation knowledge and poor boating safety practices. Similar issues are observed in the local rental company and boat club communities which result in inexperienced operators and unsafe conditions. Additionally, the large volume of recreational traffic in the vicinity of the Wappoo Creek Bridge causes waterway congestion. Operational delays in Charleston, including those caused by the Wappoo Creek Bridge operating restrictions, act as force multipliers for congestion. The waterway relies heavily on highly orchestrated transit windows to transit below the bridge which is dictated by tides, vessel drafts, and limited passing zones. When a delay occurs due to weather, mechanical failure, or terminal backups, vessels miss these critical windows, resulting in disrupted tug/pilot schedules, impacted commercial logistics and restricted Department of War (DoW) movements. A combination of all events detailed in Table 8 occur on average 59.83 times per year in the Port of Charleston. The total annual RIN cost associated with these events is estimated at \$73.21 million.

D. Risk Mitigation Strategies

1. The validated list of WRFs was used to prioritize discussion and development of risk mitigation strategies. Facilitators directed participants to capture potential mitigation strategies on sticky notes, which were then consolidated and grouped to identify major themes. Due to time constraints, risk mitigation strategies were not developed for all issues. Stakeholders were granted autonomy to develop mitigations for any of the WRFs identified with elevated risk by the Risk Characterization survey regardless of severity ranking. Participants elected to generate mitigation strategies for a selected issue from Volume of Recreational Traffic, Commercial Fishing Vessels, Congestion, Dimensions, Large Commercial Vessels, and Obstructions. Recommended mitigation strategies documented in this section received consensus among workshop participants. Mitigation strategies are documented in order of significance to participants.
2. Participant comments are listed in Appendix C of this report and are referenced throughout this subsection to provide support of documented developed mitigation strategies.
3. Appendix E of this report contains a full list of the issues that participants presented and validated, informing the development of mitigation strategies discussed below. The issues presented in Appendix E are edited for clarity and syntax.

4. WRF – Volume of Recreational Traffic.

- a. Recreational vessel operators that are unaware of safe operating areas impede commercial traffic by congregating in commercial transit areas.
 - (1) Pursue a collaborative solution with manufacturers of Electronic Charting Systems and Electronic Chart Display and Information Systems to integrate an automated alert system that uses geofencing technology to establish virtual perimeters around designated main shipping channels. Upon a vessel's approach to or entry into these demarcated zones, the system would automatically generate both visual and audible warnings to the vessel operator to improve situational awareness, function as a critical real-time safety warning, and reduce the potential for conflicts between vessels operating within or near high-traffic corridors.
 - (2) Establish a Charleston Area Harbor Safety Committee (HSC) subcommittee for public outreach to leverage social media and local news outlets. Focus this public outreach campaign on general boater safety such as right-of-way, correct display of navigation lights, and hazards of operating near commercial traffic.
 - (3) Work through the Charleston HSC to install informational signage at public boat ramps including Wappoo Cut, Remley's Point, and Shem Creek to display Quick Response (QR) codes that lead users to boater safety information resources including Navigation Rules and local tides and currents charts.
 - (4) Pursue development of local legislation in coastal counties to mandate the completion of a boating safety course as a requirement for vessel registration and renewal through the South Carolina Department of Natural Resources (SCDNR).
 - (5) Collaborate with the SCDNR to create additional incentives for course completion, such as issuing a distinct safety decal for display on vessels.
 - (6) Formally invite boat club and rental company owners to Charleston HSC meetings. Jointly develop and implement enhanced safety policies and operational practices across the boat rental community to reduce incidents and improve boater education.

5. WRF – Commercial Fishing Vessels.

a. Commercial fishing vessel operators lack knowledge of Navigation Rules and fail to monitor radio communications which lead to unsafe encounters with large vessels.

(1) Strengthen Sector Charleston’s oversight and training for personnel, including Auxiliarists, conducting dockside safety examinations, with a priority on radio communication protocols and safe navigation practices.

(2) Collaborate between the Coast Guard, local law enforcement, and SCDNR to increase direct engagement with commercial fishing vessel operators to address the behavior of mariners who fail to monitor the appropriate radio channels. Identify and implement legal mechanisms necessary to enforce radio communication requirements for the commercial fishing fleet.

6. WRF – Congestion.

a. Existing operating protocol for the Wappoo Creek Bridge, which consists of scheduled half-hour openings for recreational vessels and on-demand openings for commercial towing operations, is an operationally inefficient and rigid process. This system is ill-equipped to manage the waterway's extensive traffic, resulting in significant congestion and failing to account for the time required for safe vessel transit.

(1) Update the Wappoo Creek Bridge Operator Standard Operating Procedure (SOP) to require bridge operators to make radio broadcasts to notify mariners when a commercial vessel requires priority for bridge transit.

(2) Require vessel operators to submit timely and properly documented incident reports to the Coast Guard or the South Carolina Department of Transportation (SCDOT) for violations of the Code of Federal Regulations (CFR) related to bridge operations. Document the date, time, and a detailed description of the violation.

7. WRF – Dimensions.

a. The channel at Drum Island Reach and Myers Bend Reach is significantly confined and creates a narrow transit area. This configuration poses safety concerns which are amplified by the increasing size of vessels navigating the waterway.

- (1) Expand the feasibility study area for planned U.S. Army Corps of Engineers (USACE) channel modifications to include both the Drum Island Reach and the Myers Bend Reach. Ensure the assessment includes an analysis of the potential benefits and impacts of modifying the reaches, a definition of the technical requirements, and establishment of federal interest in the project.
 - b. Nautical charts depicting the upper Cooper River are outdated and display inaccurate depths and shorelines which contribute to risk of vessel groundings.
 - (1) Extend the federal waterway to encompass the upper Cooper River to the waterway adjacent to Cypress Gardens. Inclusion of this area as a federal waterway provides access to federal funding for routine surveying and maintenance as part of existing federal maintenance programs administered by USACE and the National Oceanographic Atmospheric Administration (NOAA).
 - (2) For non-federally managed waterways, implement a formal process whereby sponsors with commercial interests in the area may be responsible for funding hydrographic surveys. Commercial sponsors would have the option to commission either the USACE or a qualified private firm to conduct hydrographic surveys.
8. WRF – Large Commercial Vessels.
- a. Commercial vessel crews are not proficient at rigging pilot ladders or handling mooring lines, which creates safety hazards during pilot transfers and while ships are at berth.
 - (1) Collaborate with the Charleston Harbor Pilots to develop and disseminate electronic and physical comprehensive reference materials addressing key maritime operational and safety protocols. Topics covered shall include proper vessel operations, safe line handling techniques, rigging and maintenance of Jacobs ladders, standards of conduct on navigable waters, and general mariner safety issues.
 - (2) Identify and collaborate with the appropriate Coast Guard Headquarters office to draft a recommended crew proficiency requirement dictating practical demonstration of pilot ladder rigging during Port State Examinations.

9. WRF – Obstructions.

a. Although the location of the silt wall at the Federal Law Enforcement Training Center Charleston is outside the Cooper River channel, it impedes navigable waters and has resulted in multiple allisions.

(1) Through the HSC, request that the Coast Guard Sector Charleston Waterways Management Division modify the lighting configuration on the silt wall to increase and cluster the number of lights closer together to improve nighttime visibility. Currently the silt wall has four lights varying at 150-250 feet spacing and is insufficient to prevent allision.

Appendix A. Workshop Participants

Participant	Organization
1. Billy Ackerman	Amalie Oil Company
2. John Cameron	Charleston Branch Pilots Association
3. Heather Howell	Charleston County Emergency Management
4. Robert Fulmer	Charleston Fire Department
5. David Galloway	Charleston Midstream Transfer Facility
6. Eric Tuttle	Charleston Police Department
7. Forrest Urick	Fort Sumpter Ferry Tours
8. Sean O'Toole	Hapag-Lloyd
9. Steve Kicklighter	McAllister Towing
10. Karen McDonald	Moran Towing Corporation
11. Thomas Wallace	North Charleston Police Department
12. Chris Harmon	Odfjell Terminals
13. Kevin Turner	South Carolina Department of Transportation
14. Sigrid Phinney	South Carolina Law Enforcement Division
15. Garret Heatherington	South Carolina Ports Authority
16. Brandley Sinoc	United States Navy
17. Scott Hyatt	United States Army Corps of Engineers
18. Jeremy Johnson	United States Army Corps of Engineers
19. Chris Wright	United States Army Corps of Engineers
20. Andrew Czarniak	United States Coast Guard
21. Josh Daniel	United States Coast Guard
22. Matt Hooper	United States Coast Guard
23. Nick Jones	United States Coast Guard
24. Paul McCann	United States Coast Guard
25. Ben Reilly	United States Coast Guard
26. Edward Wright	United States Coast Guard
27. Rudy Socha	Wounded Nature-Working Veterans Group

Appendix B. Waterway Risk Model Terms, Definitions, and Focused Quantitative Risk Assessment (FQRA)

A. Waterway Risk Conditions and Waterway Risk Factor (WRF) Definitions. The Ports and Waterway Safety Assessment (PAWSA) Waterway Risk Model utilizes sixteen WRFs categorized under four Waterway Risk Conditions. Definitions for each Waterway Risk Condition and their associated WRF are defined in this section.

1. Waterway Risk Condition - Navigation. The environmental conditions that affect vessel navigation, such as wind, currents, and weather.
 - a. WRF - Winds. The difficulty in maneuvering vessels resulting from increased and unpredictable winds, particularly if the wind is from abeam.
 - b. WRF - Tides and Currents. The difficulty in maneuvering vessels caused by water movement flow and speed, often affected by seasonal variations and sustained winds. Tide rips and whirlpools can be created by strong currents and affect the maneuverability of smaller vessels. The frequency of occurrence and the location of the strongest currents in the waterway are critical considerations (e.g., if current speed can exceed vessel speed, timing is critical when transiting the area).
 - c. WRF - Visibility Restrictions. The natural conditions that may prevent a mariner from seeing other vessels, aids to navigation, or landmarks, such as fog, severe rain squalls, etc.
 - d. WRF - Bottom Type. The material on the waterway bottom or just outside the channel, such as hard rock, mud, coral, etc.
2. Waterway Risk Condition - Vessel Quality and Operations. The quality of vessels and their crews that operate on a waterway. Each waterway has what are considered high risk vessels, such as old vessels, vessels with poor safety records, vessels registered in certain foreign countries, vessels belonging to financially strapped owners, vessels with inexperienced crews and operators, etc. When assessing risk, the following items should be considered (as appropriate) for each risk factor: maintenance, age, flag, class society, ownership, inspection record, casualty history, language barriers, fatigue related issues, and local area knowledge.
 - a. WRF - Large Commercial Vessels. The quality of the large commercial vessel itself and the proficiency and quality of the crew. Large vessels are those ocean-going vessels, often in international trade, that usually are constrained by their draft to use dredged channels where such channels exist. Large vessels include such things as oil tankers, container ships, break bulk cargo ships, and cruise liners.

- b. WRF - Small Commercial Vessels. The quality of the small commercial vessel itself and the proficiency and quality of the crew. Small vessels include all other commercial craft EXCEPT commercial fishing vessels. Examples include tugs and towboats, offshore supply vessels, charter fishing boats, and small passenger vessels (inspected under 46 CFR Subchapters T and K), such as dinner cruises and ferries.
 - c. WRF - Commercial Fishing Vessels. The quality of the commercial fishing vessel itself and the proficiency and quality of the crew. These vessels are included because they are not required to undergo annual vessel inspections nor are the crewmembers required to hold USCG licenses; therefore, there may be a greater potential for increased incidents involving commercial fishing vessels.
 - d. WRF - Recreational Vessels. The quality of the recreational vessel itself and the proficiency and operating knowledge of the individuals who operate them. Recreational vessels include all boats used for noncommercial purposes (e.g., pleasure craft or craft used by indigenous people for transportation or subsistence fishing). They can be powered by an engine, the wind, or human exertion. Examples include yachts, personal watercraft (a.k.a., jet skis), and kayaks.
3. Waterway Risk Condition - Traffic Conditions. The number of vessels that use a waterway and their interactions.
- a. WRF - Volume of Commercial Traffic. The amount of commercial vessel traffic using the waterway (i.e., the more vessels there are on the water, the more likely that there will be a marine casualty). Deep draft and shallow draft commercial vessels as well as commercial fishing vessels are included in this risk factor. Shoreside infrastructure is also addressed in this risk factor (i.e., can it handle the volume of commercial traffic within the waterway).
 - b. WRF - Volume of Recreational Traffic. The amount of non-commercial vessel traffic using the waterway. The volume may vary depending on the time of day, the day of the week, the season of the year, or during a major marine event.
 - c. WRF - Waterway Use. The interaction between vessels or boats of different sizes using the same waterway and their maneuvering characteristics. Conflicts occur as risk increases with each type of vessel's maneuvering characteristics and actions that are often different and unpredictable (e.g. commercial mariners and recreational mariners using deep draft vessels and shallow draft vessels within the same waterway).

- d. WRF - Congestion. The ability of the waterway to handle the volume and density of traffic. Risk increases when a large number of vessels uses a small geographic area for an extended period of time. Risk also increases substantially when you get a larger than normal number of vessels together for a short time (e.g., fishing tournament or short season commercial fishery).
4. Waterway Risk Condition - Waterway Conditions. The physical properties of the waterway that affect vessel maneuverability.
- a. WRF - Visibility Impediments. The man-made objects (e.g., moored ships, condominiums, background lighting, etc.) or geographic formations (e.g., headlands, islands, etc.) that prevent a mariner from seeing aids to navigation or other vessels.
 - b. WRF - Dimensions. The room available for two vessels to pass each other within the waterway.
 - c. WRF - Obstructions. Floating objects in the water that impede safe navigation and could damage a vessel, such as ice, debris, fishing nets, etc. Fixed objects such as wrecks, pipelines, overhead wires, derelict piers, fixed bridges, and permanently moored vessels.
 - d. WRF - Configuration. The arrangement of a waterway, including elements such as waterway bends, multiple and converging channels, and perpendicular traffic flow.

B. Focused Quantitative Risk Assessment (FQRA) Background. As described in Chapter 1 Section B.2.b.(1), the Risk Index Number (RIN) is calculated for participant prioritized WRF issues using the FQRA process. Details are provided in the following sections regarding the consequence component of the FQRA.

- 1. Consequence. Table 1, as referenced in Chapter 1 Section B.2.b.(1).(a), displays the Coast Guard established consequence types, severity categories, and descriptions. Each consequence category is quantified in dollar value to allow comparison between consequence types. The fiscal equivalence for each consequence category provides economic weight for the RIN.

		Severity Categories				
		Cat 1	Cat II	Cat III	Cat IV	Cat V
Consequence Type	Safety	Injuries up to permanent disability.	One to 5 Deaths	6 to 15 Deaths	16 to 50 Deaths	51 or more Deaths
	Environmental (Oil)	Minor releases (of less than 100 gal)	Medium releases (of 100 to 5000 gal) OR local marine resource stock collapse for 1 to 5 years.	Disruption of the ecosystem (of 5000 to 50k gal) OR local marine resource stock collapse for 5 to 10 years.	Serious disruption of the ecosystem (of 50k to 500k gal) OR local marine resource stock collapse for 10-50 years.	Catastrophic disruption of the ecosystem (of more than 500k gal) OR local marine resource stock collapse for more than 50 years.
	Economic	Vessel damage, structure damage, economic activity, or port disruptions that incur less than \$50k economic losses in total.	Between \$50k and \$250k economic losses in total.	Between \$250k and \$5M economic losses in total.	Between \$5M and \$250M of economic losses in total.	More than \$250M of economic losses in total.

Table 1 – Severity categories by consequence type.

- a. The following subsections explain how monetary values for different consequences are derived for each consequence type.
 - (1) *Safety*. These estimates use the Department of Transportation value of statistical life. The guidance is intended for analysis assessing the benefits of preventing fatalities. Reflecting 2025 inflation, a single death is equivalent to \$12.5 million.
 - (2) *Environmental*. These estimates use the Environmental Protection Agency’s Basic Oil Spill Cost Estimation Model (BOSCM). This is an adaptable model that allows for customizable inputs regarding spill

recovery methods and efficiency, oil type, cultural factors, and impacted ecosystem descriptors to predict cost of an oil spill. Each of these inputs modifies the cost calculation in a different way. Once customizations for the model are set, three functions are combined to get total cost. These consist of direct response costs, socioeconomic and secondary costs, and environmental damage costs. Due to the extensive prep work required to use BOSCU, the FQRA does not customize the model for individual ports. Instead, very conservative factors are selected with a bias towards over-estimating the cost and accounting for inflation adjusted to 2025. The primary limitation of this method is that not all environmental damage is caused by oil. An analysis of environmental damage costs from all maritime incident sources is difficult to estimate. Oil spill costs are the proxy that was selected until better models are found.

- (3) *Economic*. This is the estimated dollar value for economic loss. It includes losses from vessel damage, facility damage, and economic activity.

Appendix C. Participant Comments

A. Background

1. This appendix documents participant observations and recommendations expressed during the workshop with respect to specific issues of concern within the study area. Discussion during the first day of the workshop was recorded and subsequently transcribed using professional services. Comments were compiled and categorized by most applicable Waterway Risk Condition and WRF.

B. Waterway Risk Condition – Navigation

1. WRF – Winds.

- a. NOAA regulations mandate vessel speed restrictions in designated zones to mitigate the risk of vessel strikes with North Atlantic right whales. However, these mandated speeds can be insufficient for maintaining safe control and maneuverability during high wind conditions and turbulent sea states.
- b. A sensor gap exists within the study area to assess real-time wind conditions. The limited number of wind sensors, coupled with variable wind speed and direction, lead to insufficient weather information for mariners who rely on accurate meteorological data for safe and efficient navigation.

2. WRF- Currents and Tides.

- a. Due to strong tidal currents in channel, all vessels are required to time their passage through the Wapoo Creek Bridge during slack tide. This operational constraint vessels waiting for the transit window to congregate in the channel.
- b. Drum Island Reach is characterized by a complex hydrodynamic environment resulting from the convergence of the Wando and Cooper Rivers. The strong and unpredictable currents present a significant navigational challenge large commercial vessels requiring precise maneuverability.
- c. Detailed National Oceanic Atmospheric Administration (NOAA) and U.S. Army Corps of Engineers (USACE) studies on Charleston Harbor's tides and currents provides valuable information for managing the safe passage large commercial ships navigating challenging waterway bends where strong currents are a known operational hazard.

2. WRF- Visibility Restrictions

- a. There are insufficient visibility sensors and live camera feed coverage throughout the study area. This is compounded by the absence of reliable fog forecasting and the inherent variability of fog conditions, which can differ greatly within the waterway.

4. WRF- Bottom Type

- a. During high tide, the north and south entrance jetties to Charleston Harbor become submerged and are not visible to mariners. This contributes to vessel groundings.
- b. An unidentified submerged obstruction off the coast of Fort Moultrie presents a navigational hazard. Its presence significantly narrows the navigable corridor and presents a navigational hazard to large commercial vessels.

C. Waterway Risk Condition- Vessel Quality and Operation

1. WRF- Large Commercial Vessels

- a. Underreporting of vessel casualties and mechanical failures degrade the effectiveness of marine casualty data-oriented risk assessments and proactive safety measures.
- b. Short notice “Dead ship” vessel movements can be dictated by berth availability and commercial pressures. These operations are not addressed with the same rigor as underway vessel marine casualties or pre-planned dead ship movements. Operational decisions for scheduling dead ship movements with narrow tide and current windows should be driven by comprehensive risk analysis rather than the potential for commercial profit loss.
- c. Vessel casualties, such as the Motor Vessel Golden Ray in Brunswick, Georgia, are attributed to insufficient vessel stability resulting from mismanaged cargo loading and documentation. Post-incident investigations identified flawed stability calculation processes as a root cause, yet the underlying procedural vulnerabilities remain unaddressed across the industry.

2. WRF- Small Commercial

- a. A combination of regulatory gaps for tugboats under 26 feet and insufficient enforcement of illegal charters has created a system whereby untrained and unqualified operators are common.
- b. A widening skills gap between senior and newer mariners presents a significant training challenge. Experienced mariners possess invaluable operational experience but often lack proficiency with modern electronic navigation and propulsion systems. In contrast, newer mariners are adept with technology such as Electronic Charting

Systems and integrated bridge controls but may lack the fundamental seamanship and sound judgment required in complex scenarios. This disparity complicates the development of standardized training, hinders effective mentorship, and creates inconsistent competency across vessel crews

3. WRF- Commercial Fishing Vessels

- a. The lack of a comprehensive regulatory framework and insufficient oversight across local, state, and federal jurisdictional levels permits commercial fishing vessels to operate in unsafe material condition. The absence of enforced standards elevates the risk of preventable accidents and potential catastrophic failures within the commercial fishing fleet.
- b. The failure of fishing vessels to adhere to the Navigation Rules and observe established radio communication etiquette enables unsafe encounters between fishing and large commercial vessels.

4. WRF-Recreational Vessels

- a. State licensing standards for recreational vessel operators are insufficient to ensure operators possess a comprehensive understanding of the Navigation Rules, local waterway characteristics, and fundamental boating safety principles.
- b. Boat clubs and rental companies do not require a boating license and provide no boating education prior to a customer's rental, resulting in untrained, inexperienced operators and unsafe conditions within the waterway.
- c. Recreational vessels consistently impede the safe passage of commercial traffic by operating in dangerous proximity to tugs, container ships, and other large vessels within designated navigable channels. The combined disregard for the Navigation Rules and unsafe operating practices near vessels with limited maneuverability amplifies risk of collision with recreational boaters.

D. Waterway Risk Condition – Traffic

1. WRF - Volume of Commercial Traffic

- a. Operational delays in Charleston act as force multipliers for congestion. The waterway relies heavily on highly orchestrated transit windows dictated by tides, vessel drafts, and limited passing zones. When a delay occurs- due to weather, mechanical failure, terminal backups- vessels miss these critical windows, resulting in disrupted tug/pilot schedules, restriction of both commercial logistics, and Department of War (DOW) movements.

- b. Standard labor hours and tidal currents are the primary driver of vessel transit schedules. These factors cause concentrated vessel movement periods which temporarily overwhelm port capacity, contribute to increased traffic congestion, and strain tug availability during peak times.
- c. Ongoing expansion of the port drives a significant increase in overall vessel traffic and density. This growth creates a congestion point near the Ravenel Bridge, where vessels converge at slack tide, during the required tidal window for safe transit. During these periods, the congregation of vessels restricts traffic flow and increases navigational risk.

2. WRF - Volume of Recreational Traffic

- a. Marine event sponsors demonstrate insufficient logistical planning and knowledge of maritime safety protocols. Lack of proper planning by these sponsors results in the obstruction of navigable channels and creates significant traffic congestion, which compromises the safety and efficiency of commercial and recreational vessel movements. A more rigorous marine event permit approval process that includes requirements for detailed traffic management and contingency plans is needed.
- b. Safe and efficient commercial vessel transit is impeded by high volumes of recreational traffic operating within designated commercial transit lanes. This issue stems from a lack of situational awareness and knowledge among recreational boaters regarding the increases of risk when encroaching into channels and fairways. This phenomenon creates dangerous close-quarters situations with large commercial vessels with limited maneuverability.

3. WRF – Waterway Use

- a. Boaters attribute damage caused to moored recreational vessels to wakes created by large commercial vessels. Recreational boaters consequently direct complaints against commercial vessels that are operating in full compliance with existing rules in channels that do not have defined speed limits and are not designated no-wake zones.
- b. The Port of Charleston lacks a sufficiently robust traffic management system to effectively coordinate the movement of barges and other commercial vessels. An absence of holistic oversight of vessel movements contributes to uncoordinated transits, which causes traffic impediments and compromises the efficiency of the waterway.

4. WRF – Congestion

- a. The Wappoo Creek Bridge opens every half-hour for recreational traffic and on-demand for commercial tows. This operating schedule is inefficient for managing the flow of maritime traffic, fails to account for dynamic factors such as optimal tidal windows and safe navigation requirements, and exacerbates channel congestion during closures.
- b. A bottleneck occurs in the vicinity of the Ravenel Bridge, where the Wando and Cooper Rivers merge, due to the scheduling vessel transits and berth transitions to align with the start of labor shifts. This practice creates intense, predictable periods of peak vessel movement that overwhelm the capacity of the waterway.
- c. During early mornings, hazardous traffic situations are more likely to develop due to the simultaneous departure of charter fishing boats, other recreational vessels, and large commercial vessel traffic. Widespread failure of these smaller vessels to keep clear of larger vessels with limited maneuverability impedes the safe passage of commercial ships and contributes to increased risk of collision.

E. Waterway Risk Condition – Waterway

1. WRF – Dimensions

- a. The confined geometry of Drum Island Reach and Myers Bend Reach causes navigational challenges and safety concerns due to vessels of increased vessel beam and length overall transiting the port.
- b. Charted depths for the Upper Cooper River are outdated and do not reflect actual depths. This discrepancy contributes to the danger of exposing transiting vessels to increased risk of grounding and renders passage planning unreliable.
- c. The Intracoastal Waterway, particularly in the area between the Isle of Palms and Sullivans Island bridges, is a narrow channel impacted by inaccurate charted depths and increasing dock encroachment.
- d. The current process for integrating USACE survey data into NOAA's new S-102 electronic charting standard has resulted in the creation of misleading depth information for mariners. The system defaults to displaying the deepest-ever recorded sounding in a geographic location, even if that data has since been superseded by shoaling recorded in more recent condition surveys.

3. WRF- Obstructions

- a. Although the location of the silt wall at the Federal Law Enforcement Training Center (FLETC) Charleston is outside the Cooper River channel, it impedes navigable waters and has resulted in multiple allisions
- b. Due to local pressure against opening bridges during peak vehicular traffic times, bridge operations are not always conducted in accordance with federal regulations.
- c. No clear party is identified with primary responsibility of removing floating debris from the harbor. Additionally, the port has not established a designated disposal location.

4. WRF- Visibility Impediments

- a. Permanent mooring of Maritime Administration vessels at FLETC Charleston presents a visual obstruction for vessels maneuvering through the navigable waters of the Cooper River.
- b. The effectiveness of Navigational Range 'C' at Joint Base Charleston is compromised due to overgrown vegetation that obscures the range markers.

5. WRF- Waterway Configuration

- a. To ensure continued navigational safety, immediate maintenance is required for the replacement of the radar beacon (RACON) sea buoy. This action is critical for maintaining reliable electronic navigation markers for incoming and outgoing vessel traffic.
- b. Anchorages A - D lack the required dimensions and depth desired by commercial vessel operators.
- c. An additional junction buoy is required at the Wando River Lower and Drum Island Reaches. Placement of this buoy will improve situational awareness at the intersection of these two critical maritime paths and mitigate risk for maneuvering vessels.

Appendix D. Geospatial Participant Comments

Facilitators captured participant observations that made specific geographic references. Those observations were then transferred to an ArcGIS online web-application to generate the chartlets reflecting the location and specific context of each comment. The chartlets are included below and represented as Figures 1-3.

Geospatial Comments	
Point	Comment
1	A hydrographic survey and risk assessment are needed to evaluate the potential effects of removing the illuminated silt wall located near Cooper River Dike Light 49A by the Federal Law Enforcement Training Center Charleston’s (FLETC) small boat piers. This structure poses a navigational hazard to vessels operating outside the designated channel due to its low visibility.
2	Determine and chart the Ravenel Bridge’s vertical clearance from mean high water in the Cooper River shipping channel.
3	Add a junction buoy at the intersection of Wando Lower Reach and Drum Island Reach, south of Daniel Island.
4	The connection at Drum Island Reach and Myers Bend restricts large commercial vessels. Consideration for an alternate channel configuration design to accommodate larger vessels is recommended.
5	Due to its positioning, visual alignment with the Bennis Reach Range occurs too early for inbound vessels and too late for outbound vessels. Recommend adjustment of the range counterclockwise to shift its alignment to the Charleston Harbor North Channel.
6	Crab Bank has expanded into the Shem Creek Channel, resulting in shallower areas as compared to charted depths. This has enabled an increase in vessel groundings.
7	Include Charleston Harbor anchorages in future National Oceanic Atmospheric Administration hydrographic surveys.
8	A submerged hazard, comprised of rock and shoaling-related sedimentation, was identified inshore and north of Charleston Harbor Channel Lighted Buoy 24. This feature constricts the navigable channel and poses a significant hull-breach risk to transiting vessels.
9	Replace the existing Charleston Entrance Lighted Buoy “C” with a 9’ x 35’ Lighted Whistle Radar Reflector (LWR) to improve visibility and radar return.

Table 1- Geospatial Comments.

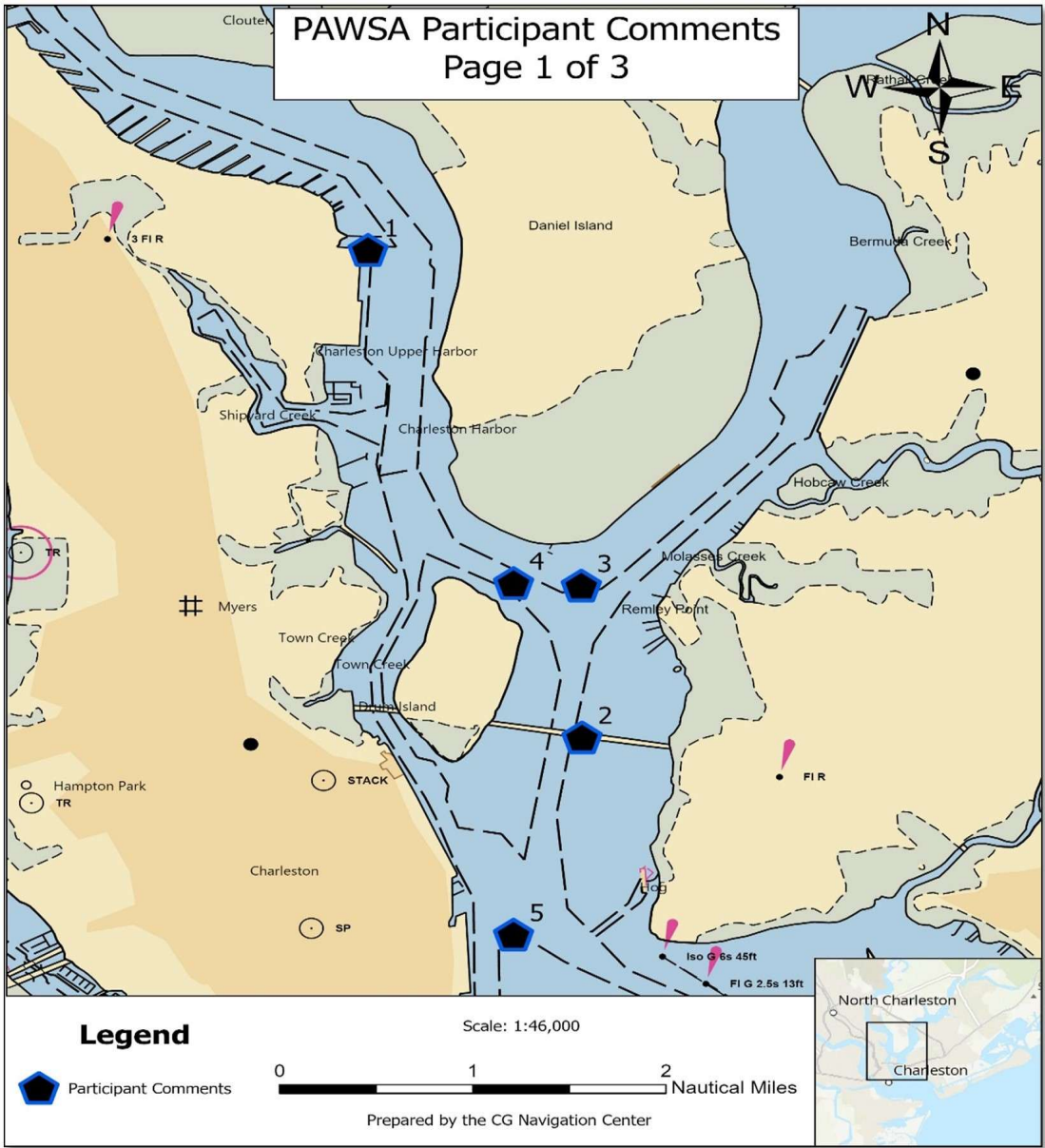


Figure 1- Mapped location of geospatial participant comments 1-5.

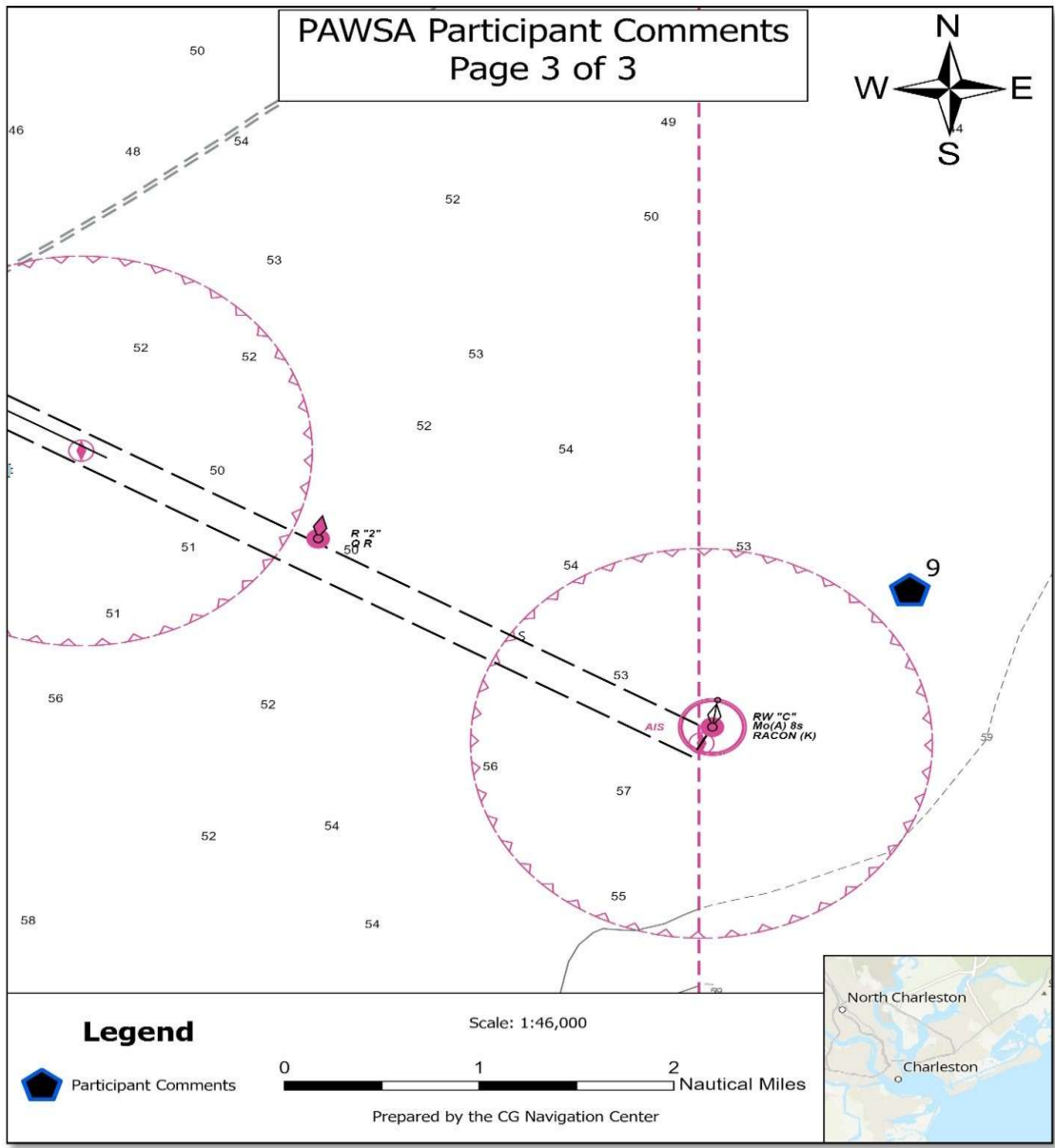


Figure 3- Mapped location of geospatial participant comment 9.

Appendix E. Waterway Risk Factor Issues

Following Day 1 workshop discussions, participants were asked to identify the most concerning issues for the highest prioritized and validated WRFs from the Risk Characterization survey. The following is a summary of the prioritized issues as selected by the participants. These issues are not listed in priority order and are also documented in Chapter 2.C preceding each mitigation strategy.

A. Waterway Risk Condition - Navigation

1. WRF – Winds

- a. Vessel operators cannot comply with NOAA’s safe speed requirements for Right Whale zones and simultaneously maintain safe maneuverability in high and lateral winds.
- b. Mariners receive inconsistent wind information because current wind sensors are insufficient and cannot account for the inherent variability of wind speed and direction within the study area.

2. WRF – Currents and Tides

- a. Tidal currents in the channel limit vessel transits through the Wappoo Creek Bridge to slack tide which results in vessel congestion.
- b. The convergence of the Wando and Cooper Rivers produces strong, variable currents at Drum Island Reach that affect the safe transit of large commercial vessels.

3. WRF – Visibility Restrictions

- a. The study area contains insufficient sensors or cameras for mariners to monitor visibility. Fog predictions are unreliable, and visibility conditions vary by location.

4. WRF – Bottom Type

- a. The north and south entrance jetties, which are not visible at high tide, have led to groundings, vessel losses, and loss of life.
- b. A shallow jetty constricts the navigable channel near Fort Moultrie and presents a significant risk of hull damage to vessels. This navigational hazard has led to multiple grounding incidents, including those involving a U.S. Navy patrol boat and recreational watercraft. These occurrences have most frequently been reported during high tides and at night, when the jetty is least visible.

B. Waterway Risk Condition – Vessel Quality and Operation

1. WRF – Large Commercial Vessels

- a. A failure to adequately report major vessel casualties and mechanical malfunctions creates a significant information gap. This lack of critical data severely hampers the ability to implement proactive safety measures and risk mitigation strategies, thereby increasing the probability of catastrophic maritime events including collisions, allisions, and groundings within the study area.
- b. Movements of “dead ships,” or vessels operating without their own propulsion, constitute the most high-risk vessels in the port. Despite the elevated risk, these operations are frequently executed without the same level of rigorous planning and formal risk analysis applied to pre-planned dead-ship vessel transits with substantial lead time, because of competing commercial or logistical pressures.
- c. Commercial vessel crews are not proficient at rigging pilot ladders or handling mooring lines, which creates safety hazards during pilot transfers and while ships are at berth.

2. WRF – Small Commercial Vessels

- a. The absence of regulatory oversight for towing vessels under 26 feet, coupled with the insufficient enforcement of illegal charter boat operations increases the presence of unqualified operators and general risk of the waterway.
- b. There is a growing disparity between experienced mariners, who possess valuable hands-on experience but may lack proficiency with modern integrated navigation and digital systems, and their less experienced counterparts who are more digitally literate but lack comparative experience. This schism creates inefficiencies and conflicts in the training process and professional development of new operators.

3. WRF – Commercial Fishing Vessels

- a. Lax regulation and oversight of the material condition of older commercial fishing vessels create unsafe conditions.
- b. Commercial fishing vessel operators lack knowledge of Navigation Rules and fail to monitor radio communications which lead to unsafe encounters with large vessels.
- c. Crab traps set in the Cooper River Shipping Channel are navigational hazards and create a fowling risk to vessel propulsion systems.

4. WRF – Recreational Vessels

- a. Inadequate state licensing requirements for recreational boaters contribute to vessel operators that lack adequate knowledge of Navigation Rules, the local waterway, and safe boating practices.
- b. Boat clubs and rental companies that do not require a boating license or provide boating education enable the presence of untrained and inexperienced operators on the waterway.
- c. Recreational vessels disregard the Navigation Rules and operate in the navigable channel in dangerous proximity to tugs, tows, and large ships.

C. Waterway Risk Condition – Traffic

1. WRF – Volume of Commercial Traffic

- a. Limited dredging availability prevents maintaining the channel to its charted depth, increases traffic congestion, and contributes to altering of the natural flow of traffic to avoid shallow areas.
- b. Efforts to synchronize vessel movements with labor start times and favorable tidal windows result in operational bottlenecks. This practice concentrates a high volume of traffic into narrow operational timeframes which contributes to channel congestion and overwhelms the port's available tug resources.
- c. Expansion of the port has increased traffic, vessel congestion, and created a choke point at the Ravenel Bridge.

2. WRF – Volume of Recreational Traffic

- a. Marine events organized by sponsors who are unfamiliar with commercial shipping schedules and maritime safety protocols lead to inadequate planning. This results in navigational obstructions that impede waterway access and disrupt the flow of commercial traffic.
- b. Recreational vessel operators that are unaware of safe operating areas impede commercial traffic by congregating in commercial transit areas.

3. WRF – Waterway Use

- a. Wakes from commercial traffic are the primary cause of damage to vessels moored in Charleston Harbor Marina. The adjacent navigational channel, Charleston Harbor North Channel, is not presently designated as a designated “No Wake” zone and lacks regulatory speed restrictions.

b. The waterway lacks a traffic management system to support commercial traffic.

4. WRF – Congestion

a. Existing operating protocol for the Wappoo Creek Bridge, which consists of scheduled half-hour openings for recreational vessels and on-demand openings for commercial towing operations, is an operationally inefficient and rigid process. This system is ill-equipped to manage the waterway's extensive traffic, resulting in significant congestion and failing to account for the time required for safe vessel transit.

b. Recreational vessel traffic congests turning basins used by commercial vessels and tugs to perform complex maneuvers.

c. Compressing vessel transits and berth transitions into narrow timeframes aligned with shoreside labor schedules prevents proactive vessel traffic management and contributes to high traffic density situations that increase operational risk for all waterway users.

d. Charter fishing and recreational vessels departing the harbor in the morning fail to keep clear of commercial vessel traffic and exacerbate waterway congestion.

D. Waterway Risk Condition – Waterway

1. WRF – Dimensions

a. Nautical charts depicting the upper Cooper River are outdated and display inaccurate depths and shorelines which contribute to risk of vessel groundings.

b. The Intracoastal Waterway, particularly in the area between the Isle of Palms and Sullivans Island bridges, is a narrow channel impacted by inaccurate charted depths and increasing dock encroachment.

c. The channel at Drum Island Reach and Myers Bend Reach is significantly confined and creates a narrow transit area. This configuration poses safety concerns which are amplified by the increasing size of vessels navigating the waterway.

2. WRF – Obstructions

a. Although the location of the silt wall at the Federal Law Enforcement Training Center (FLETC) Charleston is outside the Cooper River channel, it impedes navigable waters and has resulted in multiple allisions.

b. Due to local pressure against opening bridges during peak vehicular traffic times, bridge operations do not follow federal regulations.

- c. Improperly maintained fendering and lighting on bridges also create navigational hazards to bridges.
 - d. There is a lack of coordination or identification of a clear party responsible for removing floating debris from the harbor. Additionally, the port and its stakeholders have not established a designated disposal location.
3. WRF – Visibility Impediments
- a. Permanent mooring of Maritime Administration vessels at FLETC Charleston presents a visual obstruction for vessels maneuvering through the navigable waters of the Cooper River.
 - b. The effectiveness of Navigational Range 'C' at Joint Base Charleston is compromised due to overgrown vegetation that obscures the range markers.
4. WRF – Configuration
- a. To ensure continued navigational safety, immediate maintenance is required for the replacement of the radar beacon (RACON) sea buoy. This action is critical for maintaining reliable electronic navigation markers for incoming and outgoing vessel traffic.
 - b. Maintenance efforts must include the realignment of range sectors and flashing intervals throughout Charleston Harbor. Precise calibration of these visual aids is necessary to provide accurate guidance and prevent navigational errors within the harbor's primary channels.
 - c. An additional junction buoy is required at the Wando River Lower and Drum Island Reaches. Placement of this buoy will improve situational awareness at the intersection of these two critical maritime paths and mitigate risk for maneuvering vessels.
 - d. Anchorages A - D lack the required dimensions and depth desired by commercial vessel operators.

Appendix F. National and Local Event and Consequence Data

A. National and Local Event and Consequence Data. As referenced in Chapter 1 Section B.2.b.(1)(c), the following section displays the tables and definitions for event types included in the handout provided to stakeholders prior to conducting the FQRA. The model uses national and local Coast Guard MISLE data that are both updated as appropriate. The national event data in Table 1 contains information through September 2025. Table 2 and 3 contain the local event data for Sector Charleston that was derived prior to the workshop.

1. Event Types. During the FQRA process on the second day of the PAWSA, participants complete Event Forms that are pre-populated with issues validated during the first day of the PAWSA to enable RIN value calculations. An example of an event form completed by participants for this workshop is included below as Figure 1.

PAWSA Location: Charleston	Risk Factor: Recreational Vessel Quality
Team Number: 3	

Issue	Event	Frequency
The current licensing requirements for recreational vessels are not adequate in ensuring proper knowledge of Navigation Rules, knowledge of the waterway, or boating safety practices creating unsafe vessel operations.	Collision	Probable
	Grounding	Probable
	Allision	Frequent
	Traffic Restricted	Frequent
Boat clubs and rental companies do not require a boating license and provide no boating education prior to a customer's rental resulting in untrained, inexperienced operators and unsafe conditions within the waterway.	Traffic Restricted	Frequent
	Collision	Probable
	Allision	Probable
	Grounding	Probable
Recreational vessels operate in the navigable channel in dangerously close proximity of tug and tows, large commercial and container ships with no regard to Navigation Rules and limited or no knowledge of safe vessel operation.	Traffic Restricted	Frequent
	Collision	Probable
	Allision	Frequent
	Grounding	Probable

Populated by PAWSA facilitators based on Day 1

Completed by Participants on Day 2

Figure 1 – Example event form from the Sector Charleston PAWSA.

2. For each issue listed, participants select up to three event types that may occur due to the associated issue. For example, if "Groundings throughout the study area can cause the waterway to shut down for an extensive amount of time" is the issue, then allision, grounding, or traffic restricted are examples of three event types a participant may select that could occur because of this issue. Definitions for the nine event types available during the FQRA are provided below:

- i. **Allision:** Vessel runs into stationary structure.
- ii. **Collision:** Vessel runs into another vessel.
- iii. **Fire/Explosion:** Fire or explosion.
- iv. **Grounding:** Vessel draft exceeds water depth.
- v. **HAZMAT Release:** Hazardous Material container breached or no longer working as designed (tank, package, pipe, etc.)
- vi. **Infrastructure Failure:** Infrastructure stops working or damaged from non-vessel source.
- vii. **Oil Spill:** Oil container breached or no longer working as designed (tank, pipe, etc.)
- viii. **Sinking:** Vessel stops floating as designed. Capsizing is a sub-type of sinking.
- ix. **Traffic Restricted:** Traffic not flowing normally; NOT from any event listed.

3. National Events. Table 3 provides data capturing the record of the yearly average of national events used in the FQRA process.

National Events		
Event	Total Events	Yearly Avg
Allision	11,179	429.96
Collision	3,118	119.92
Fire/Explosion	2,442	93.92
Grounding	14,794	569.00
Oil Spill	77,603	2,984.73
Sinking	4,457	171.42
Traffic Restricted	6,816	262.15
Total	120,409	4,631.12

Table 1 – Total and yearly average of national events.

4. Local Events. The data capturing the record of local events used in the FQRA process is specific to the port for the PAWSA. Table 2 and 3 provide the local event and consequence data provided to stakeholders prior to conducting the FQRA for the Sector Charleston PAWSA workshop.

Local Events		
Event	Total Events	Yearly Avg
Allision	75	2.9
Collision	12	0.5
Fire/Explosion	17	0.7
Grounding	56	2.2
Oil Spill	542	20.8
Sinking	39	1.5
Traffic Restricted	54	2.1
Total	795	30.6

Table 2 – Total and yearly average of local events for the Sector Charleston PAWSA workshop study area.

Local Event Consequences							
Type	Allision	Collision	Fire/Explosion	Grounding	Oil Spill	Sinking	Traffic Restricted
Economic							
Ec0	Probable	Occasional	Occasional	Probable	Frequent	Probable	Occasional
Ec1	Probable	Occasional	Occasional	Occasional	Rare	Occasional	Probable
Ec2	Occasional	Occasional	Occasional	Occasional	Occasional	Occasional	Occasional
Ec3	Occasional		Rare			Occasional	Occasional
Ec4							Rare
Environmental							
En0	Frequent	Occasional	Probable	Probable	Probable	Probable	
En1			Occasional	Occasional	Frequent	Occasional	
En2				Occasional	Probable	Occasional	
En3					Rare	Rare	

Table 3 – Local event consequences and likelihood for the Sector Charleston PAWSA workshop study area.