Ports and Waterways Safety Assessment

Workshop Report

Corpus Christi, Texas

2–3 September, 2015

United States Coast Guard

Marine Transportation Systems Directorate

Providing Navigation Safety Information
for America's Waterways Users

Executive Summary

The United States Coast Guard (USCG), Marine Transportation System Management Directorate, is responsible for developing and implementing policies and procedures that facilitate commerce, improve safety and efficiency, and inspire dialogue with port and waterways users with the goal of making waterways as safe, efficient, and commercially viable as possible.

Through the 1997 Coast Guard Appropriations Act, the Coast Guard was directed to establish a process to identify minimum user requirements for new Vessel Traffic Service (VTS) systems in consultation with local officials, waterways users and port authorities, and also to review private/public partnership opportunities in VTS operations. The Coast Guard convened a National Dialogue Group (NDG) comprised of maritime and waterway community stakeholders to identify the needs of waterway users with respect to Vessel Traffic Management (VTM) and VTS systems. The NDG was intended to provide the foundation for the development of an approach to VTM that would meet the shared government, industry, and public objective of ensuring the safety of vessel traffic in U.S. ports and waterways, in a technologically sound and cost effective way.

From the NDG came the development of the ***Ports and Waterways Safety Assessment (PAWSA) Waterway Risk Model*** and the ***PAWSA workshop process***. PAWSA is a disciplined approach designed to identify major waterway safety hazards, estimate risk levels, evaluate potential mitigation measures, and set the stage for the implementation of selected risk reduction strategies. The process involves convening a select group of waterway users and stakeholders and facilitating a structured workshop agenda to meet the risk assessment objectives. A successful workshop requires the participation of professional waterway users with local expertise in navigation, waterway conditions, and port safety. In addition, stakeholders are included in the process to ensure that important environmental, public safety, and economic consequences are given appropriate attention as risk interventions are selected.

The long-term goals of the PAWSA process are to:

1) Provide input when planning for projects to improve the safety of navigation,
2) Further the Marine Transportation System goals of improved coordination and cooperation between government and the private sector, and involving stakeholders in decisions affecting them,
3) Foster development and/or strengthen the roles of Harbor Safety Committees within each port, and
4) Support and reinforce the role of Coast Guard Sector Commanders/Captains of the Port in promoting waterway and vessel traffic management activities within their geographic areas of responsibility.

Over 50 ports/waterways have been assessed using the PAWSA process. The risk assessment process represents a significant part of joint public-private sector planning for mitigating risk in waterways. When applied consistently and uniformly in a number of waterways, the process is expected to provide a basis for making best value decisions for risk mitigation investments, both on the local and national level.

The goal is to find solutions that are cost effective and meet the needs of waterway users and stakeholders.

PAWSA Waterway Risk Model/PAWSA Workshop Process

The PAWSA Waterway Risk Model includes variables dealing with both the causes of waterway casualties and their consequences. In the Waterway Risk Model, risk is defined as a function of the probability of a casualty and its consequences. The risk model includes variables associated with both the causes and effects of vessel casualties. The diagram below shows the six general risk categories and corresponding risk factors that make up the Waterway Risk Model.

PAWSA Waterway Risk Model					
Vessel Conditions	**Traffic Conditions**	**Navigational Conditions**	**Waterway Conditions**	**Immediate Consequences**	**Subsequent Consequences**
Deep Draft Vessel Quality	Volume of Commercial Traffic	Winds	Visibility Impediments	Personnel Injuries	Health and Safety
Shallow Draft Vessel Quality	Volume of Small Craft Traffic	Water Movement	Dimensions	Petroleum Discharge	Environmental
Commercial Fishing Vessel Quality	Traffic Mix	Visibility Restrictions	Bottom Type	Hazardous Materials Release	Aquatic Resources
Small Craft Quality	Congestion	Obstructions	Configuration	Mobility	Economic

- ***Vessel Conditions*** – The quality of vessels and their crews that operate on a waterway.
- ***Traffic Conditions*** – The number of vessels that use a waterway and how they interact with each other.
- ***Navigational Conditions*** – The environmental conditions that vessels must deal with in a waterway.
- ***Waterway Conditions*** –The physical properties of the waterway that affect vessel maneuverability.
- ***Immediate Consequences*** – The instantaneous impacts to the port as a result of a vessel casualty.
- ***Subsequent Consequences*** – The longer-term impacts felt days, months, and even years afterwards.

Workshop activities include a series of discussions about the port/waterway attributes and the vessels that use the waterway, followed by completion of survey books to establish baseline risk levels, evaluate the effectiveness of existing risk mitigations, and identify additional risk intervention strategies to further reduce risk in the port/waterway. *Survey Book 1* is used to numerically evaluate the baseline risk levels using pre-defined qualitative risk descriptions for pre-defined risk factors. *Survey Book 2* is used to assess the expertise of each other with respect to the risk categories in the model. Those expertise assessments are used to weight inputs obtained during the other steps in the workshop process. *Survey Book 3* is used to evaluate how effective existing mitigation strategies are at reducing risks, and to determine if the risks are well-balanced or not. For those risk factors where risk is judged to be unbalanced by existing mitigations, participants complete *Survey Book 4* to identify additional risk intervention strategies, and then evaluate how effective those new strategies could be at reducing risks.

Corpus Christi PAWSA Workshop

A PAWSA workshop for the Port of Corpus Christi was held in Corpus Christi, Texas on 2-3 September 2015. The workshop was attended by 28 participants, representing waterway users, regulatory authorities, and stakeholders with an interest in the safe and efficient use of the Corpus Christi Harbor from both a commercial and recreational perspective. Participants discussed and evaluated 24 of the 24 risk factors that make up the Waterway Risk Model. Participants discussed the various types of vessels operating within the port's waterways system, challenges vessel operators faced when navigating amongst recreational boaters and smaller commercial vessels, and the risks associated with a complete shutdown of any part of the port system.

For each of the 24 risk factors evaluated, participants discussed and then numerically evaluated the baseline risk levels using pre-defined qualitative risk descriptions for each risk factor. Participants then discussed existing risk mitigation strategies, evaluated how effective the mitigation strategies were at reducing risk, and then determined if the risks were well balanced. For 15 of the 24 risk factors evaluated, there was consensus (defined as 2/3 of the workshop participant teams being in agreement) that risks were well-balanced by existing mitigations. There were not any risk factors that participants believed in a consensus were NOT well-balanced. For 9 risk factors (Shallow Draft Vessel Quality, Commercial Fishing Vessel Quality, Small Craft Quality, Volume of Commercial Traffic, Volume of Small Craft Traffic, Traffic Mix, Hazardous Materials Release, Mobility, Economic), there was not a consensus that risks were well-balanced by existing mitigations.

For these 9 risk factors, the participants engaged in further discussions to identify additional risk intervention strategies, and then they evaluated how effective those new strategies could be at reducing risks. To further reduce risks relating to Commercial Fishing Vessel Quality and Small Craft Quality, 5 of the 15 participant teams recommended increased mandatory training for these vessel operators and 4 of the 15 participant teams recommended mandatory VTS participation and AIS outfitting. To reduce risks associated with Waterway Configuration, 4 of the 15 participant teams agreed that continued dredging and widening of the channels should be pursued. To further reduce risks for the Economic risk factor, all 15 of the participant teams agreed that the collective port efforts were focused on minimizing economic disruptions and that continued contingency planning and drills/exercises were the best mechanisms to reduce risk.

The results of the baseline risk level survey, existing risk mitigation strategies, additional risk interventions strategies, and participant comments and observations regarding the Port of Corpus Christi, are outlined in this report with supporting data that was computed using the PAWSA Waterway Risk Model.

Conclusion

The goal of a PAWSA workshop is not only to further the Marine Transportation System (MTS) objective of improved coordination and cooperation between government and the private sector, and involving stakeholders in decisions affecting them, but to provide the Coast Guard Sector and District Commanders and members of the waterway community with an effective tool to evaluate risk and work toward long term solutions tailored to local circumstances. The goal is to find solutions that are both cost effective and meet the needs of waterway users and stakeholders. In support of this goal, this report should be viewed as a starting point for continuing dialogue within Corpus Christi's maritime community.

The United States Coast Guard, Marine Transportation System Management Directorate, extends a sincere appreciation to the workshop participants for their contributions to the Corpus Christi PAWSA Workshop. Their expertise was critical to the success of the workshop, and their recommendations will greatly assist the Coast Guard as it continues to work with the maritime community to further improve safety and efficiency in the Port of Corpus Christi, Texas.

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Section 1: Corpus Christi PAWSA - Assessment Area

The geographic area assessed during the workshop included the Corpus Christi port approaches; the participant teams agreed to limit their assessment to the waterways and harbor as depicted in NOAA Charts 11309, 11311, and 11312 (see **Figures 1**, **2, and 3** below). **Figure 4** below depicts satellite imagery of the geographic area discussed.

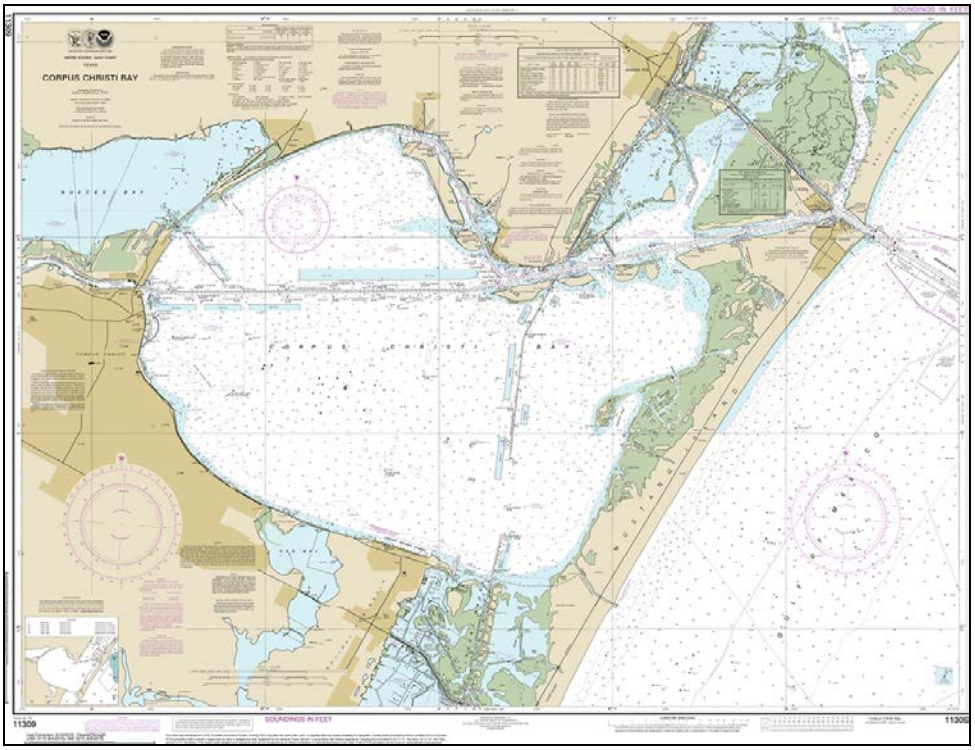

Figure 1: NOAA Chart 11309 – Corpus Christi Bay

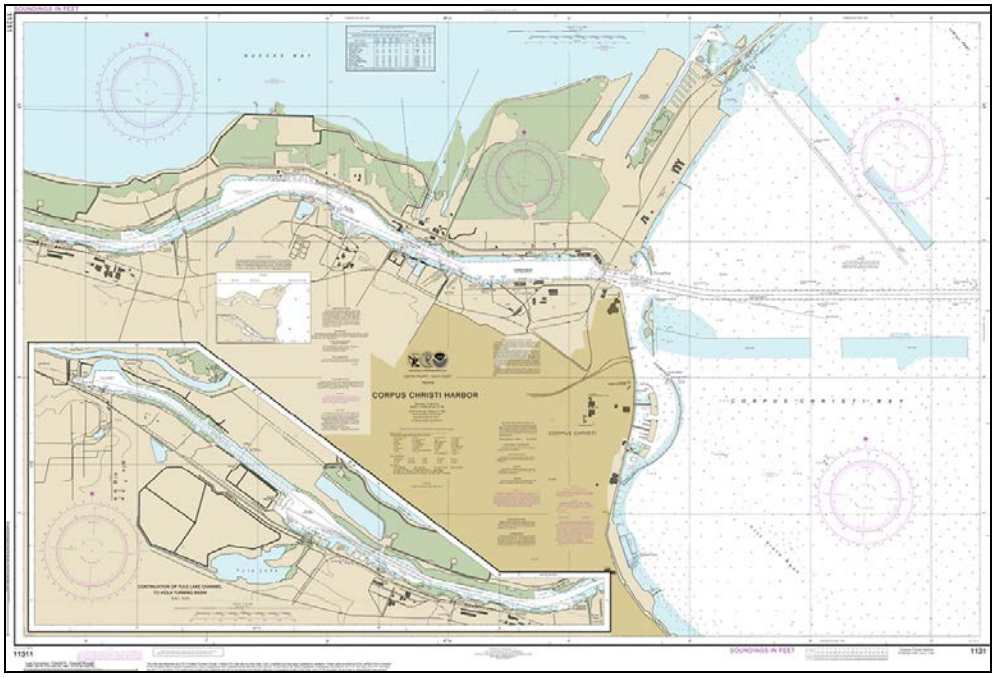

Figure 2: NOAA Chart 11311 – Corpus Christi Harbor

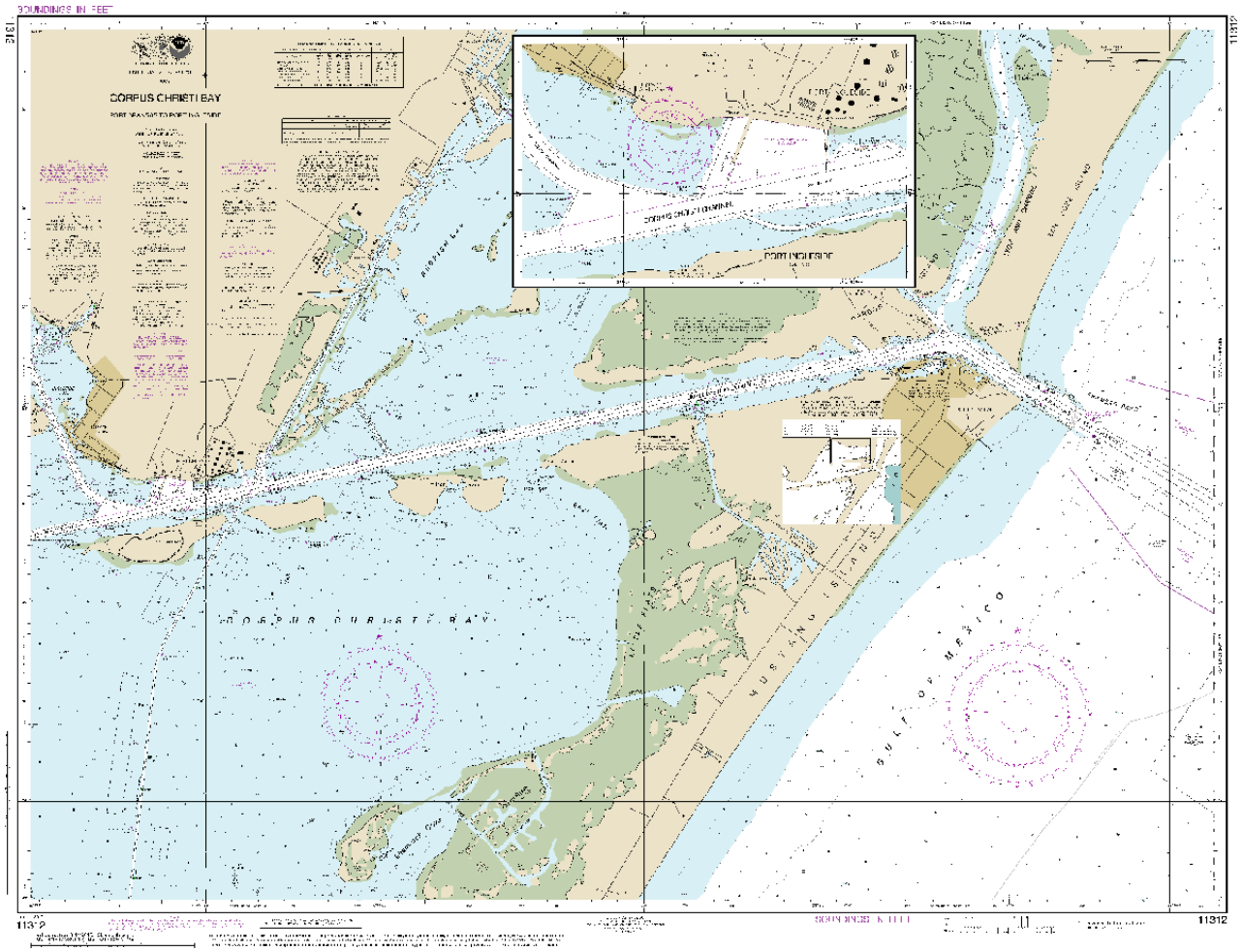

Figure 3: NOAA Chart 11312 – Corpus Christi Bay/Port Aransas

Figure 4: Satellite Imagery of Harbors and Waterways Assessed

Section 2: Baseline Risk Levels

The first step in the workshop was the completion of *Survey Book 1* used to determine a baseline risk level value for each risk factor in the Waterway Risk Model. Participants discussed each of the 24 risk factors in the Waterway Risk Model and selected a qualitative description for each risk factor that best described the conditions in the port. These qualitative descriptions were then converted to numerical values. On those scales, 1.0 represents low risk (best case) and 9.0 represents high risk (worst case), with 5.0 being the mid-risk value.

Figure 5 below shows that 9 of 24 risk factors were scored at or above the mid-risk value. Risk values highlighted in red (values at or above 7.7) denote very high baseline risk levels; risk values highlighted in green (values at or below 2.3) denote very low baseline risk levels.

Baseline Risk Levels					
Vessel Conditions	**Traffic Conditions**	**Navigational Conditions**	**Waterway Conditions**	**Immediate Consequences**	**Subsequent Consequences**
Deep Draft Vessel Quality	Volume of Commercial Traffic	Winds	Visibility Impediments	Personnel Injuries	Health and Safety
4.3	7.0	4.4	6.0	6.6	8.7
Shallow Draft Vessel Quality	Volume of Small Craft Traffic	Water Movement	Dimensions	Petroleum Discharge	Environmental
6.6	6.5	2.9	6.6	9.0	8.3
Commercial Fishing Vessel Quality	Traffic Mix	Visibility Restrictions	Bottom Type	Hazardous Materials Release	Aquatic Resources
8.7	6.7	5.3	2.8	9.0	6.1
Small Craft Quality	Congestion	Obstructions	Configuration	Mobility	Economic
8.2	6.1	2.1	8.5	8.7	8.8

Figure 5: *Survey Book 1* Results - Baseline Risk Levels

As the participants discussed each of the 24 risk factors, their comments and observations were documented for inclusion in this report. An Electronic Charting System (ECS) was also utilized to plot the charted location associated with participant comments and observations, and assign a risk factor marker number for that specific comment and/or observation. **Appendix B** includes participant comments and observations and **Appendix E** includes ECS extracts with the plotted locations associated with the comment/observation.

Section 3: Team Expertise Cross-Assessment

The second step in the workshop was the completion of *Survey Book 2* to perform a team expertise cross-assessment. The team expertise cross-assessment was conducted early in the workshop process and was used to weigh the relative strengths of each team with respect to the six risk categories. The results of the team expertise cross-assessments were used to weight the inputs that each team provided in the other workbooks completed during the workshop.

After being presented with the concepts underlying the model, each participant team was asked to discuss (among themselves) how their background and experience aligns with the model. They then verbally presented their conclusions to the other teams. These presentations gave all the teams a sense of where everyone thought their respective subject matter expertise strengths and weaknesses were in relation to the risk factors being analyzed. After all teams had spoken, each team then evaluated whether they were in the top, middle, or lower third of all teams present with respect to knowledge and expertise in the six risk category areas.

The participants assessed their own and all the other participant teams' level of expertise for each of the six categories in the Waterway Risk Model. As depicted in **Figure 6** below, 46% of the participant teams were placed in the upper third, 27% in the middle third, and 27% in the lower third of all teams. While the "ideal" split should be closer to a 33%-33%-33% distribution, the expertise in the room was strong and adequately distributed for all categories.

Figure 6 further breaks down the participants' expertise for each risk category highlighting in yellow those assessments that were on the high or low ends from expected distribution values.

Team Expertise -- Distribution

Risk Category	Top 1/3	Mid 1/3	Lower 1/3
Vessel Conditions	51%	19%	31%
Traffic Conditions	42%	31%	27%
Navigational Conditions	53%	26%	21%
Waterway Conditions	43%	34%	23%
Immediate Consequences	43%	29%	28%
Subsequent Consequences	42%	26%	32%
All Categories Average	46%	27%	27%

Figure 6: *Survey Book 2* Results - Team Expertise Cross-Assessment

Section 4: Existing Risk Mitigation Strategies

The third step in the PAWSA workshop asked participants to evaluate the effectiveness of existing mitigation strategies in reducing the risk level for each risk factor. Participants discussed existing risk mitigations for all risk factors in the model, and then evaluated how effective they thought the mitigations were at reducing risks using *Survey Book 3*.

- or 15 risk factors (green), there was consensus that risks were well balanced by existing mitigations.
- or 9 risk factors (yellow), there was no consensus that risks were well balanced by existing mitigations.
- or 0 risk factors (red), there was consensus that risks were NOT well balanced by existing mitigations.

Consensus is defined as 2/3 of the workshop participant teams being in agreement.

Figure 7: *Survey Book 3* Results - Existing Risk Mitigation Strategies

Mitigation Effectiveness												
Vessel Conditions		**Traffic Conditions**		**Navigational Conditions**		**Waterway Conditions**		**Immediate Consequences**		**Subsequent Consequences**	
Deep Draft Vessel Quality		Volume of Commercial Traffic		Winds		Visibility Impediments		Personnel Injuries		Health and Safety	
4.3	3.0	7.0	5.9	4.4	3.5	6.0	4.4	6.6	4.7	8.7	6.0
Balanced		Maybe		Balanced		Balanced		Balanced		Balanced	
Shallow Draft Vessel Quality		Volume of Small Craft Traffic		Water Movement		Dimensions		Petroleum Discharge		Environmental	
6.6	5.1	6.5	5.4	2.9	3.3	6.6	4.6	9.0	7.2	8.3	6.4
Maybe		Maybe		Balanced		Balanced		Balanced		Balanced	
Commercial Fishing Vessel Quality		Traffic Mix		Visibility Restrictions		Bottom Type		Hazardous Materials Release		Aquatic Resources	
8.7	7.2	6.7	6.2	5.3	3.9	2.8	2.1	9.0	7.3	6.1	5.5
Maybe		Maybe		Balanced		Balanced		Maybe		Balanced	
Small Craft Quality		Congestion		Obstructions		Configuration		Mobility		Economic	
8.2	7.2	6.1	4.4	2.1	1.6	8.5	5.7	8.7	7.3	8.8	7.7
Maybe		Balanced		Balanced		Balanced		Maybe		Maybe	

Risk Factor	
Book 1 Score	Book 3 Score
Consensus Reached ?	

	EXPLANATION
Book 1	Level of risk - not taking into account existing mitigations
Book 3	Level of risk - taking into account existing mitigations
Balanced	Consensus that risks are well balanced by existing mitigations
Maybe	No Consensus that risks are well balanced by existing mitigations
Rising	Mitigated risk level is higher than the baseline risk level
NO	Consensus that existing mitigations do NOT adequately balance risk

Section 5: Additional Risk Intervention Strategies

The workshop participants next completed *Survey Book 4* for those risk factors that did not reach a consensus as being balanced by existing mitigations (Shallow Draft Vessel Quality, Commercial Fishing Vessel Quality, Small Craft Quality, Volume of Commercial Traffic, Volume of Small Craft Traffic, Traffic Mix, Hazardous Materials Release, Mobility, and Economic). Participants suggested additional risk intervention strategies and then evaluated how successful a proposed risk intervention will be at lowering risk levels for each of the risk factors.

Discussion emphasized those risk factors that were found to be higher than the baseline risk level. To further reduce risks relating to Vessel Conditions, 5 of the 14 participant teams recommended increased mandatory training for these vessel operators and 4 of the 14 participant teams recommended mandatory VTS participation and AIS outfitting. To reduce risks associated with Traffic Conditions and Waterway Conditions, all 14 of the participant teams agreed that continued dredging and widening of the channels should be pursued. To further reduce risks for the Immediate and Subsequent Consequences risk factors, all 14 of the participant teams agreed that the collective port efforts were focused on minimizing economic disruptions and that continued contingency planning and drills/exercises were the best mechanisms to reduce risk.

Appendix C is a description of each proposed risk intervention strategy and **Appendix D** describes all risk intervention strategies proposed and evaluated by the participants.

Figure 8 below shows the expected reduction in risk when taking the actions specified by the participants.

Figure 8: *Survey Book 4* Results - Additional Risk Intervention Strategies

Additional Interventions					
Vessel Conditions	**Traffic Conditions**	**Navigational Conditions**	**Waterway Conditions**	**Immediate Consequences**	**Subsequent Consequences**
Deep Draft Vessel Quality	Volume of Commercial Traffic	Winds	Visibility Impediments	Personnel Injuries	Health and Safety
Balanced	Waterway Changes	Balanced	Balanced	Balanced	Balanced
	5.6				
Shallow Draft Vessel Quality	Volume of Small Craft Traffic	Water Movement	Dimensions	Petroleum Discharge	Environmental
Waterway Changes	Waterway Changes	Balanced	Balanced	Balanced	Balanced
4.4	5.3				
Commercial Fishing Vessel Quality	Traffic Mix	Visibility Restrictions	Bottom Type	Hazardous Materials Release	Aquatic Resources
Rules & Procedures	Waterway Changes	Balanced	Balanced	Coordination / Planning	Balanced
7.1	5.9			7.1	
Small Craft Quality	Congestion	Obstructions	Configuration	Mobility	Economic
Voluntary Training	Balanced	Balanced	Balanced	Other Actions	Other Actions
4.6				6.4 Caution	7.3 Caution

Risk Factor
Intervention Category
Risk Outcome

	EXPLANATION
Intervention Category	Intervention general strategy that most participants selected for furthur risk mitigation actions.
Risk Outcome	The expected risk outcome, the risk level that could be obtained if new mitigation measures were implemented

Section 6: Future Risk Discussion – Proposed/Planned Infrastructure

At the conclusion of the workshop, participants discussed issues and potential risks associated with future port expansion projects and the addition of a new critical infrastructure. The Harbor Safety Committee started an ad hoc subcommittee to address future growth and increased vessel traffic; the subcommittee plans to hire an outside consultant to conduct the traffic and safety/security risk study.

The discussion cited that the Port of Corpus Christi has undergone a change in its shipping profile over the last two years; the current profile has oil and LPG being shipped out while LNG is coming in. This dynamic has resulted in a $32B investment in planning and enhancements to the port system. The size of ships is not projected to grow; the turning basin limits vessel length to 1,000 feet. Unless a new facility is to be constructed at Harbor Island, it is unlikely that vessels larger than Suez Max ships will be able to call upon the port. The addition of the Cheniere terminal and Ingleside LPG project will have the biggest impacts on annual ship calls. This additional volume which is projected to be over 700 additional ship calls per year will require additional tug boats and pilots. Until the actual demand is realized, tug operators and the pilots will monitor the situation before they commit to adding additional resources and training new employees. Security implications will also affect congestion, pace, and sequencing of ships entering and leaving. In anticipation of the impending growth, the harbormaster has requested to increase the watch from a two-person to three-person team.

Over the last two years, inland water traffic has doubled as a result of heavy barge traffic; existing inner harbor facilities are planning to build additional docks to add berth capacity. In 2017, construction will begin on the Harbor Bridge and run for approximately four years not including the time to take down the existing bridge. The participants discussed the possibility of implementing security zones as a mitigation effort and to assist with controlling the increased amount of harbor and channel traffic.

The following markers were placed on the ECS to capture future infrastructure and risk considerations for the port:

- *Marker FutureProj 1* (see **Figure 17**): New LNG, Cheniere, Voestelpine
- *Marker FutureProj 2* (see **Figure 18**): New Harbor Bridge
- *Marker FutureProj 3* (see **Figure 17**): Cheniere Bulk Liquids Terminal
- *Marker FutureProj 3* to *FutureProj 4* (see **Figure 17**): La Quinta Channel, possible security zone
- *Marker FutureProj 5* (see **Figure 17**): Cheniere LNG Terminal
- *Marker FutureProj 6* (see **Figure 17**): Oxy Ingleside Energy Center

Appendix A - Workshop Participants

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Appendix B

Participant Observations - Trends in the Port and Existing Risk Mitigations

Deep Draft Vessel Quality

Trends/Observations:

Note: To ensure standardization throughout all PAWSA Workshops, a deep draft vessel is defined as any vessel with a draft of 12 feet or greater.

It was discussed that vessel age was not as big a factor as maintenance. For example, one tanker that calls upon the port was built in 1975 but is maintained perfectly. Other vessels built in the 2000s are not as well maintained. One of the biggest issues comes from mechanical failures associated with fuel switching; it was noted that three to four failures occur per year. Generally, this means when pitch is leveled, the engine stalls and will not start. However, there is a "misfire" nearly every day, which means they are not able to have the engine react as quickly as they should or would with normal fuel. Loss of steering or ship power occurs outside the main ship channel; there were three occurrences last year. The participants cited language barriers for ships operating with a mixed crew—Greek, Filipino, Chinese, and others. Another language barrier noted was local slang and maritime vernacular that is not common to international cultures. Participants noted that many ships demonstrated a lack of operational knowledge which increased the potential risk while using the waterways.

Existing Mitigations:

- "White listing" and noting vessels that have traditionally had crew or mechanical concerns
- Pilots maintain a log of vessel conditions so they are aware of potential conditions before going onboard
- Oil companies have a vetting program to approve ships before coming to port; areas monitored include: past terminal experience, port state control, OCIMF reports, crewing, and self-inspections
- USCG mandated safety security zones
- Mandatory tug and pilots
- Port State Control program
- 96-hour notification of any problems on a vessel; rejection level is minimal
- Ship agents query ships on mechanical issues which are then relayed to the USCG and harbormaster
- Random inspections to verify reporting

Shallow Draft Vessel Quality

Trends/Observations:

Note: To ensure standardization throughout all PAWSA Workshops, a shallow draft vessel is defined as any vessel with a draft less than 12 feet (not including commercial fishing vessels in this category).

Participants noted that many ships demonstrated a lack of operational knowledge which increased potential risk while using the waterways. A large expansion in the brown water industry has resulted in barge traffic doubling over the last year. Increased activity has produced a trend of people assuming more senior positions earlier in their career; this results in a lack of experience among operators. The lack of local area experience is often found in radio communications where operators are trying to determine where they should go. The USCG noted that on the (Intracoastal Waterway) ICW, people have not been updating their charts. Also, there have been a number of changes to names of terminals which causes confusion particularly among this class of vessels.

Another trend is that approximately 80% of large recreational boat owners are not proficient in maintaining their vessels; these inadequate mariners often run into weather problems because they did not check the weather forecasts.

Existing Mitigations:

- Licensing, annual inspections
- Regular updates to charts (hard and digital); however, this group is not as reliable as deep draft vessels with regard to making these updates
- Ferries: extensive training program in varying levels of operating conditions before they are allowed to serve as a captain; inspected regularly and rigorously
- Tugs: required to have a licensed officer on the bridge at all times. Training program including simulator training

Commercial Fishing Vessel Quality

Trends/Observations:

Participants noted that commercial fishing vessel quality is generally poor for numerous reasons. Vessels are not well maintained and tend to be old; they rarely answer the radio and tend to cut corners wherever possible to optimize fishing operations. Like many other U.S. ports, the size of the fleet has diminished from 40 to 12 with the majority being bay shrimpers; this is attributed to the captain license buyback program. In Corpus Christi, there are 30 Gulf licenses, 42 Bay licenses, and 58 bait licenses. A large number of vessels come from other locations like Florida. There is currently no commercial fishing representative on the Harbor Safety Committee.

The following markers were placed on the ECS:

- *Markers CommFish 1, CommFish 2* (see **Figure 11**): fishermen/shrimpers impeding safe passage

Existing Mitigations:

- Future regulations require licensed engineers but will not cover the bay shrimpers
- Random inspections conducted on offshore commercial fishing vessels
- Optional commercial fishing vessel voluntary inspection program
- Marine surveyors inspect offshore fishing vessels for purposes of insurance
- GLO also conducts inspections from an environmental perspective
- The diminishing industry is a mitigation due to fewer vessels on the water

Small Craft Quality

Trends/Observations:

Lack of operational knowledge is a significant contributor to incidents and close calls for this class of vessels. Up to 80% of the vessels are in poor condition due to lack of maintenance as observed in the marinas. Lydia Ann Channel is a common kayaking location which often comes into conflict with recreational fishermen and larger vessels. Jet Skis pay no attention to any form of Rules of the Road. Good communications were noted between commercial shipping and the USCG to identify DUI recreational boaters.

The following markers were placed on the ECS:

- *Marker SmCraft 1* (see **Figure 11**); congestion and conflict area for small craft and jet skis
- *Marker SmCraft 2* (see **Figure 11**): Jet Ski congestion area that impacts commercial shipping
- *Marker SmCraft 3* (see **Figure 11**): congestion area for Jet Skis and kayaks that impacts commercial shipping and the ship channel traffic

Existing Mitigations:

- Marine survey required by insurance companies for the more expensive boats
- Voluntary training exists but very few people actually take advantage of it
- Boater safety requirements (state)
- More extensive requirements for guides with regard to safety equipment and mechanical condition
- Marinas enforce issues of derelict boats and poor maintenance; they also offer monthly newsletter with mechanical and safety tips
- Mitigations are diminished due to transients that live in inland Texas and come to the coast only on occasion
- State boating outreach
- State guide license required which also requires a captain's license

Volume of Commercial Traffic

Trends/Observations:

Volume continues to trend upward for commercial ship arrivals – in 2014, there were 1,599 ships arrivals compared to 1,470 in 2013. Barge arrivals also are trending upward – in 2014, there were 6,980 arrivals compared to 5,385 in 2013. The number of docks has not changed, but efficiency has improved. There are also increased numbers of vessels that are forced to wait up to 8 miles offshore. Optimization has been reached and there is no room for further enhancements given the existing conditions. It was noted that the port does not have any tide gauges or NOAA controlled air gap sensors under the bridge.

The following table shows hours of pilot operations disruption due to rig moves, disabled ships, object obstruction, and extinguished range light:

Year	Rig Move	Dead Ship	Obstruction	Extinguished Range light
2012	87.51	10.58	0	0
2013	54.67	0	0	0
2014	18.83	0	4.5	0
2015 (8/31)	68.5	0	0	17.5

The following markers were placed on the ECS:

- *Marker VolComm 1* (see **Figure 12**): principal route for barges

Existing Mitigations:

- Restrictions on certain parts of the channel to prevent close crossing of large vessels
- Ship channel is well marked
- Policies and rules to manage traffic (when, distribution, sequencing)
- AIS (but not mandatory)
- Mandatory tugs and pilots

Volume of Small Craft Traffic

Trends/Observations:

Volume of small craft is seasonal and heaviest Memorial Day through Labor Day. Fishing tournaments are trending upward in both the number of events and the participation. Boats have also become much faster with many of the boats racing to fishing spots at speeds up to 70 knots.

Existing Mitigations:

- Friday to Sunday is three to four times heavier than during the week, meaning during the week, the risk diminishes
- Letters going out to kayakers and boating associations to promote self-enforcement of safety procedures
- Safety signage at boat ramps (noted that more signage is needed)
- USCG permitting requirements for special events and tournaments

Traffic Mix

Trends/Observations:

The waterways exhibit a large mix of vessels with increasing levels of interaction and conflicts. Small vessels are not aware of the wake and impact of the wake caused by large ships. Ferries often suspend operations temporarily when large ships pass because they can be pulled away from the dock. Ferries also run into conflicts with small vessels on a regular basis.

The following markers were placed on the ECS:

- *Marker TrafMx 1* (see **Figure 12**)**;** crossing traffic, ferries
- *Marker TrafMx 2* (see **Figure 12**)**;** crossing traffic

Existing Mitigations:

- Speed limitations
- Safety zones and escorts for LPG and military offload
- High level of awareness among commercial operators including tug, towing, pilots and captains

Congestion

Trends/Observations:

Increasing congestion has caused times when pilots and tugs are backlogged or unavailable. Rig builders close down the channel when they move a rig; this causes a proactive effort within the port to ramp up operations to get ahead of the imminent slowdown. Beam restrictions at Cut A and Cut B help to alleviate congestion. Dock congestion occurs at several docks which delays ship movements. The choke point at the inner harbor was cited as an area that can quickly close down the channel should heavy congestion or an incident occur. The Port Aransas to Ingleside area is problematic for vessels operating at higher speeds which pushes water over the wall and can affect beachcombers.

The following markers were placed on the ECS:

- *MarkerCong 1* (see **Figure 12**): congestion
- *MarkerCong 2* (see **Figure 12**): Citgo and ADM boat, wait 24 hours

Existing Mitigations:

- Pilots and harbormaster employ a system of prioritization
- New anchorage for tugs and barges away from the channel
- New barge fleeting area away from the channel
- Lydia Ann Channel barges—have been moved further to the banks

Winds

Trends/Observations:

Strongest period of winds is during winter and spring; winds tend to be often steady at 20 knots with half of the days exceeding 20 knots at the peak of winter and spring. Also, there is a diurnal with low winds in the morning and evening. The leading edge of Northers can reach sustained winds of 70 knots for up to an hour. Winds tend to have significant impacts on recreational boaters since they do not pay much attention to weather forecasts. The prevailing wind direction is from the SE. The Lydia Ann Channel can funnel winds and increase the impact on the vessels operating in the area. Degradation of communications due to high winds has happened in the past, but impacts have diminished in recent years.

The following table shows the number of pilot hours disrupted from fog, wind, current, and hurricanes:

Year	Fog	Wind	Current (set)	Hurricane/Tropical Storm
2012	394.64	81	0	0
2013	326.25	71.83	32.92	0
2014	818.49	42.25	0	0
2015 (8/31)	416.06	12.25	31.92	22.83

The following markers were placed on the ECS:

- *Marker Winds 1* (see **Figure 13**): open water
- *Markers Winds 2, Winds 3, Winds 4* (see **Figure 13**): higher tides, rough bay conditions in wake of cold fronts
- *Marker Winds 5* (see **Figure 13**): strongest winds are channeled in wake of cold fronts, wind gusts on average 30-40 mph

Existing Mitigations:

- Forecasting and observation availability
- Double up tows when winds are high
- Delaying operations when winds are excessive
- Small craft advisories
- National Weather Service and marinas put out information on conditions and practices
- Good seamanship that dictates caution or avoidance

Water Movement

Trends/Observations:

In general, currents require compensation but do not cause any particularly noteworthy risks. An ebb tide at Lydia Ann Island will result in 2 to 3 knots coming from three directions. Sustained high winds affect currents and can actually reverse natural currents. Participants agreed that winds are a far greater problem than currents.

The following markers were placed on the ECS:

- *Marker WatMov 1* (see **Figure 13**): Lydia Ann Channel
- *Marker WatMov 2* (see **Figure 13**): ferry landing

Existing Mitigations:

- Published tide tables assist, but local knowledge prevails as wind has a greater affect on water movement than natural tides and currents

Visibility Restrictions

Trends/Observations:

For approximately 30 days out of the year, visibility is reduced to less than ¼ mile. November through March is the fog season with January/March being the worst months. Fog can persist between 12 and 18 hours. Harbormaster and pilots work together to move ships when safest; some delays can last from 12 to 24 hours. Along the coast, the fog does not usually persist due to high winds.

The following markers were placed on the ECS:

- *Marker VisRes 1* (see **Figure 13**): visibility due to dense fog, visibility less than 1 mile occurs 30-40 times per year

Existing Mitigations:

- Reports on visibility from stationary platforms, webcams, and satellite observations
- Dense fog advisory if visibility drops below 1 mile
- Restriction of movement based on visibility conditions

Obstructions

Trends/Observations:

In general, there are no problems with storm-induced debris. Dredging operations result in an occasional recreational craft running into pipes; there have been cases of dredge pipe breaking free and are unlit. Oil rigs that have lights extinguished are difficult to see at night and during inclement weather.

Existing Mitigations:

- No mitigations noted.

Visibility Impediments

Trends/Observations:

Inbound background lighting contributes to the biggest visibility impediment within the waterways. Dock owners are putting colored lights on docks causing navigational confusion. The size of ships and shipboard obstructions reduce visibility forward for up to a mile and close aboard both port and starboard.

The following markers were placed on the ECS:

- *Marker VisImp 1* (see **Figure 15**): Harbor Bridge

Existing Mitigations:

- Experience of known impediments and professional compensation

Dimensions

Trends/Observations:

Current channel widths require single passage for vessels beyond specified beams. Participants cited the growing need to increase channel dimensions to accommodate the increasing volume of traffic and larger ships.

The following markers were placed on the ECS:

- *Marker Dim 1 to Dim 2* (see **Figure 14**): cut A beam restriction, 500 ft width channel, 2 vessels not to exceed 265 ft wide

- *Marker Dim 3 to Dim 4* (see **Figure 14**): cut B beam restriction, 2 vessels not to exceed 215 ft, 400 ft channel

Existing Mitigations:

- No mitigations noted

Bottom Type

Trends/Observations:

The bottom type throughout the waterways is mostly sand, silt, and mud; the only rocks are in the north on the Rockport side. "Skimming" the bottom is often brought to the attention of the Army Corps of Engineers.

Existing Mitigations:

- No mitigations noted.

Configuration

Trends/Observations:

Turn maneuvers themselves are not of particular concern, however, the combination with winds/currents can make a couple of the turns tricky according to the pilots.

The following markers were placed on the ECS:

- *Marker Config 1* (see **Figure 14**): 43 degree turn with currents
- *Marker Config 2* (see **Figure 14**): La Quinta Channel, 80 degree turn
- *Marker Config 3* (see **Figure 14**): 60-70 degree turn
- *Marker Config 4* (see **Figure 15**): 60 degree turn

Existing Mitigations:

- Captain of the Port orders
- Constant communications between vessels and harbormaster
- Sufficient aids to navigation
- Pilot/harbormaster prioritization and organization of traffic

Personnel Injuries

Trends/Observations:

No cruise ships operate in the Port of Corpus Christi; ferries hold less than 150 people. The only vessel that exceeds 150 passengers is the gambling boat which goes out twice a day and holds up to 300 persons.

The following marker was placed on the ECS:

- *Marker PerInj 1* (see **Figure 16**): casino boat

Existing Mitigations:

- It is believed that there has been none or little interaction with the gambling vessel regarding emergency response; the gambling vessel has contacted local authorities to tell them how they will respond
- Rapid response by USCG including mass casualty plan

- Ferries have extensive planning, training, and exercises
- 11 county area around Corpus Christi just completed a mass casualty plan

Petroleum Discharge

Trends/Observations:

Petroleum products continue to increase movement throughout the port; approximately 800 million barrels depart the port annually. The largest ships using the waterways carry 950,000 barrels. Barge capacity is about 30,000 barrels and ocean going barges hold up to 300,000 barrels. Ships are getting larger while the waterway remains the same size. The number of actual discharges has dropped dramatically since the 1990s. It was discussed that Corpus Christi is not well-prepared for a worst-case scenario of a ship collision with a barge in the midst of a flood tide.

Existing Mitigations:

- All vessels have a response plan
- State, commercial, federal cooperation for oil spill exercises
- Adequate contract response capabilities including a cooperative agency to which all users contribute
- Distributed resources along the coast that can be on scene within hours
- Excellent vessel construction minimizes likelihood of spills
- There is a fire boat, but it is not set up for oil spill recovery
- Personnel training standards have improved greatly resulting in most discharges arising from equipment (i.e. hose) failure

Hazardous Materials Release

Trends/Observations:

There is a daily shipment of approximately 40,000 tons of hazardous materials (HAZMAT) throughout the port; barges are transporting HAZMAT also. There is only a marginal container business with the majority of transport being bulk shipments.

Existing Mitigations:

- Same mitigations as Petroleum Discharge above
- Personal Protection Equipment (PPE) is the big difference between the two mitigations; generally, first responders are expecting a petroleum discharge which results in delays to get the appropriate PPE in place
- Extensive air monitoring in the area for academic and regulatory compliance that is available to first responders; includes mobile monitors (hand held) and a release warning system with limited modeling of danger areas to assist with evacuation execution
- USCG Auxiliary runs an HF HAM radio group to assist in emergencies

Mobility

Trends/Observations:

Participants discussed an older collision incident that resulted in the release of a highly flammable substance and consequently closed the Naval Station and required a ship sortie to sea; the wind was from the southeast and pushed the product to the northwest part of the bay. Midway through the response, the wind shifted 180 degrees and the product was blown to the southeast portion of the bay. Recently a storage tank was struck by lightning that resulted in a spill. In another event a benzene tank was struck by lightning resulting in a fire. Cooperation among fire responders is in place, but there is inadequate training and experience among shore-based firefighters for shipboard firefighting.

Existing Mitigations:

- Fire barge can be mobilized within 2 hours
- Redundancy for fire monitors and geographic distribution
- Vessel plans include POCs for recovery operations
- Heavy lift salvage is not located locally; nearest available resources is Galveston

Health and Safety

Trends/Observations:

Corpus Christi's population is 315,000 with another 40,000 on the north side. Effects on the population depend on what time of the year—particularly with respect to seasonal residents, transient residents, prevailing winds, and strength of winds.

Existing Mitigations:

- Zoning requirements and oil facilities buying adjacent property to create a buffer zone
- Regular drills and exercises
- Public alarm/alert system, reverse alert, reverse 911, and media plans
- 2 active Local Emergency Planning Committees (LEPC) in the area

Environmental

Trends/Observations:

Participants stated that all the areas surrounding the ship channels and the bay are environmentally sensitive.

The following markers were placed on the ECS:

- *Marker Env 1* (see **Figure 16**): marine mammals
- *Marker Env 2* (see **Figure 16**): bird rookery
- *Marker Env 3* (see **Figure 16**): wetlands remediation
- *Marker Env 4* (see **Figure 16**): endangered species

Existing Mitigations:

- Same response actions as petroleum discharge—the most likely thing to damage the environment
- Restoration of damage and erosion control measures in place
- Location of refineries in dead-end channels which assist in isolating spills; there is enough boom on hand to block the channel

Aquatic Resources

Trends/Observations:

Shrimp, oyster and crabs are harvested within the port area. Recreational fishing is very dense and no recreational fishing is permitted inside the inner harbor.

The following marker was placed on the ECS:

- *Marker AqRes 1* (see **Figure 16**): shrimping

Existing Mitigations:

- Restocking
- Patrols to monitor various species
- Regulations against uprooting sea grass
- Parks and wildlife monitors and responds to algal blooms
- Mangrove restoration

Economic

Trends/Observations:

Economic impacts of a major maritime transportation incident would affect the U.S. economy. Given that 10% of U.S. gasoline is transported through Corpus Christi, there would be an immediate rise on gasoline prices throughout the country.

Existing Mitigations:

- Summation of all prior mitigations
- Refineries would begin shutting down after 24 hours of a major maritime incident
- Harbormaster would prioritize ships to move in and out in cooperation with stakeholders
- Good working relationship and cooperation among stakeholders

Appendix C

Definitions – Risk Mitigation Strategies

Coordination/Planning	Improve long-range and/or contingency planning and better coordinate activities/improve dialogue between waterway stakeholders
Voluntary Training	Establish/use voluntary programs to educate mariners/boaters in topics related to waterway safety (Rules of the Road, ship/boat handling, etc.)
Rules & Procedures	Establish/refine rules, regulations, policies, or procedures (navigation rules, pilot rules, standard operating procedures, licensing, required training and education, etc.)
Enforcement	More actively enforce existing rules/policies (navigation rules, vessel inspection regulations, standards of care, etc.)
Navigation/Hydro Info	Improve navigation and hydrographic information (Notice to Mariners, charts, Coast Pilots, Light Lists, Automatic Identification System (AIS), tides and current tables, etc.)
Communications	Improve the ability to communicate bridge-to-bridge or ship-to-shore (radio reception coverage, signal strength, reduce interference & congestion, monitoring, etc.)
Active Traffic Mgmt	Establish/improve a Vessel Traffic Service: information/navigation/traffic organization
Waterway Changes	Widen/deepen/straighten the channel and/or improve the aids to navigation (buoys, ranges, lights, DGPS, etc.)
Other Actions	Risk mitigation measures needed that do not fall under any of the above strategy categories

Appendix D

Additional Risk Intervention Strategies

For those categories assessed where risk was determined to be unbalanced with existing mitigation strategies, additional risk intervention strategies were proposed by teams as outlined below. (The number listed before each risk intervention strategy is the number of participant teams out of 14 who voted for that particular risk intervention strategy.)

Shallow Draft Vessel Quality

Coordination/Planning:

- (1) Safety calls at designated points

Voluntary Training:

- (1) Voluntary Training: Additional training

Rules & Procedures:

- (1) Additional required training
- (2) Application of upcoming AIS coverage rules
- (1) Stricter rules

Enforcement:

- (1) More funding for inspections
- (1) More citations

Navigation/Hydro Info:

- (3) Install tide level/wind/current monitoring system
- (1) PORTS
- (1) AIS

Communications:

- (1) Reporting points
- (1) Standard phrases
- (3) Install AIS

Active Traffic Management:

- (2) VTS
- (1) Widen/deepen channel
- (1) Set reporting points
- (2) AIS

Waterway Changes:

- (4) Barge Shelves
- (2) Separate from deep draft
- (1) Wider and deeper channel

Other Actions:

- (1) Cut new channel

Commercial Fishing Vessel Quality

Coordination/Planning:

- (1) Biannual inspections

Voluntary Training:

- (2) Make training mandatory
- (1) Establish
- (1) Boater safety
- (1) Outreach program

Rules & Procedures:

- (3) Additional required training
- (1) ROTR testing
- (3) Outlaw single man operations
- (1) Prove seaworthiness
- (1) Licensing
- (1) Stricter rules

Enforcement:

- (3) Increased inspections
- (1) High fines for violations
- (1) More citations

Communications:

- (1) Install AIS systems
- (2) Stand radio watch

Other Actions:

- (1) Basic Seamanship
- (1) Driving license for waterway
- (1) Every commercial fishing vessel must be insured

Small Craft Quality

Voluntary Training:

- (1) Possible state license for operators
- (4) Required additional training
- (1) Require an operator's license
- (1) Outreach program

Rules & Procedures:

- (1) Required education and testing
- (5) Required training/inspection/license
- (1) Stricter rules

Enforcement:

- (5) Increased inspections
- (1) Aggressive enforcement
- (1) More citations
- (1) Boat operation license

- (1) Maintenance log/inspection

Other Actions:
- (2) Require "drivers license"
- (1) Ad campaign on boat safety
- (2) Check boat seaworthiness biannually with state inspection

Volume of Commercial Traffic

Coordination/Planning:
- (1) Better sharing of schedules

Rules & Procedures:
- (1) AIS

Navigation/Hydro Info:
- (1) Real time sensors for tides and currents
- (1) PORTS, TCOON, TABS
- (1) AIS

Communications:
- (1) Designate points for safety calls
- (1) VTS

Active Traffic Management:
- (2) VTS System
- (1) AIS

Waterway Changes:
- (12) Widen and deepen channel
- (1) Additional Channels
- (2) Barge shelves

Volume of Small Craft Traffic

Rules & Procedures:
- (1) License and inspection

Enforcement:
- (1) More presence

Navigation/Hydro Info:
- (1) PORTS, TCOON, TABS

Communications:
- (1) Require radios

Active Traffic Management:
- (1) Establish small craft law
- (1) Safe zones/lanes

Waterway Changes:

- (6) Widen and deepen channel
- (1) Additional Channel

Other Actions:

- (2) Barge Shelves

Traffic Mix

Rules & Procedures:

- (1) Follow present traffic requirements
- (1) Safe zones/lanes

Enforcement:

- (1) Compliance Audit

Navigation/Hydro Info:

- (2) Real time sensors for tides and currents
- (1) PORTS, TCOON, TABS

Active Traffic Management:

- (2) VTS System
- (1) AIS

Waterway Changes:

- (7) Widen and deepen channel
- (1) Additional channels
- (1) Barge shelves

Other Actions:

- (1) Barge Shelves

Hazardous Material Release

Coordination/Planning:

- (3) Notify public/evacuation plan
- (2) Drills
- (1) More interaction between public
- (2) Exercise design/planners
- (1) Tabletop exercises
- (1) Coordinate reverse 911
- (1) Responding agencies training together more often

Voluntary Training:

- (1) Real-time Drills
- (1) Increase training
- (1) Hazmat carriers
- (1) Focused drills
- (1) Local responder training
- (1) Coordination training

Rules & Procedures:

- (1) More drills and exercises
- (1) Separate group at Harbor Safety Committee
- (1) Integrate public notification
- (1) Exercise contingency plan for multi-jurisdiction

Enforcement:

- (1) Better funding for inspections

Navigation/Hydro Info:

- (1) Tide/current/wind gauges

Communications:

- (1) Public notification coordination
- (1) Better in-sync equipment
- (1) Use of common radio channels

Waterway Changes:

- (1) Widen channel

Other Actions:

- (2) Stockpile response equipment in high-risk areas
- (1) More people involved in drill planning
- (1) Ensure responders are knowledgeable and equipped for hazmat response
- (1) Plan water based drills in ship channel
- (1) Fireboat
- (1) Additional planning depth for planning of drills

Mobility

Coordination/Planning:

- (1) Improve dialogue between port stakeholders
- (1) Who is responsible for response
- (1) Pilot coordination

Voluntary Training:

- (1) Teach rules of the road more often

Rules & Procedures:

- (1) Pilot/port/USCG rules and regulations

Enforcement:

- (1) Better funding for inspections

Navigation/Hydro Info:

- (1) PORTS
- (1) Tide/current/wind gauges

Communications:

- (1) Area-wide commonality
- (1) Mandatory communications training

- (1) More robust radio communications

Active Traffic Management:
- (1) Additional fleeting areas
- (1) VTS to reduce risk of collision

Waterway Changes:
- (1) Additional channels
- (3) Expansion (widening) to reduce likelihood a collision/incident would close the waterway

Other Actions:
- (2) Table Top exercises involving all stakeholders
- (4) Ensure salvage equipment and personnel are in our area not hours away
- (2) Fire boats

Economic

Coordination/Planning:
- (3) Improve dialogue between port stakeholders
- (1) Planners and personnel
- (1) More coordination and planning

Voluntary Training:
- (1) Exercise and table top drills

Rules and Procedures:
- (1) Constant change of response assets to match traffic

Enforcement:
- (1) Enforce the rules
- (1) Stiff fines for failure

Navigation/Hydro Info:
- (1) PORTS

Active Traffic Management:
- (1) VTS to reduce risk of collision

Waterway Changes:
- (4) Additional waterway/channel
- (4) Widen channel
- (2) Deepen ship channel

Other Actions:
- (1) Pre-stage salvage equipment closer to at risk areas
- (1) Increased budge for safety
- (1) Expanded roads (or new) roads to provide alternate evacuation corridors
- (1) Additional planning staff to help put a cost on recovery mitigation through drill and exercises
- (1) Efficient use of existing training resources

Appendix E

Electronic Charting System (ECS) Risk Factor Locations

As the workshop participants discussed each of the 24 risk factors, an ECS was utilized to plot the geographic locations associated with their comments and observations and assign a risk factor marker number for that specific comment and/or observation. The diagram below describes the ECS marker color and numbering symbols for each risk factor in the PAWSA Waterways Risk Model.

Figure 9: Risk Factor Marker Table

Vessel Conditions	Traffic Conditions	Navigational Conditions	Waterway Conditions	Immediate Consequences	Subsequent Consequences
Deep Draft Vessel Quality	Volume of Commercial Traffic	Winds	Visibility Impediments	Personnel Injuries	Health and Safety
1	1	1	1	1	5
Shallow Draft Vessel Quality	Volume of Small Craft	Water Movement	Dimensions	Petroleum Discharge	Environmental
2	2	2	2	2	6
Commercial Fishing Vessel Quality	Traffic Mix	Visibility Restrictions	Bottom Type	Hazardous Materials Release	Aquatic Resources
3	3	3	3	3	7
Small Craft Quality	Congestion	Obstructions	Configuration	Mobility	Economic
4	4	4	4	4	8

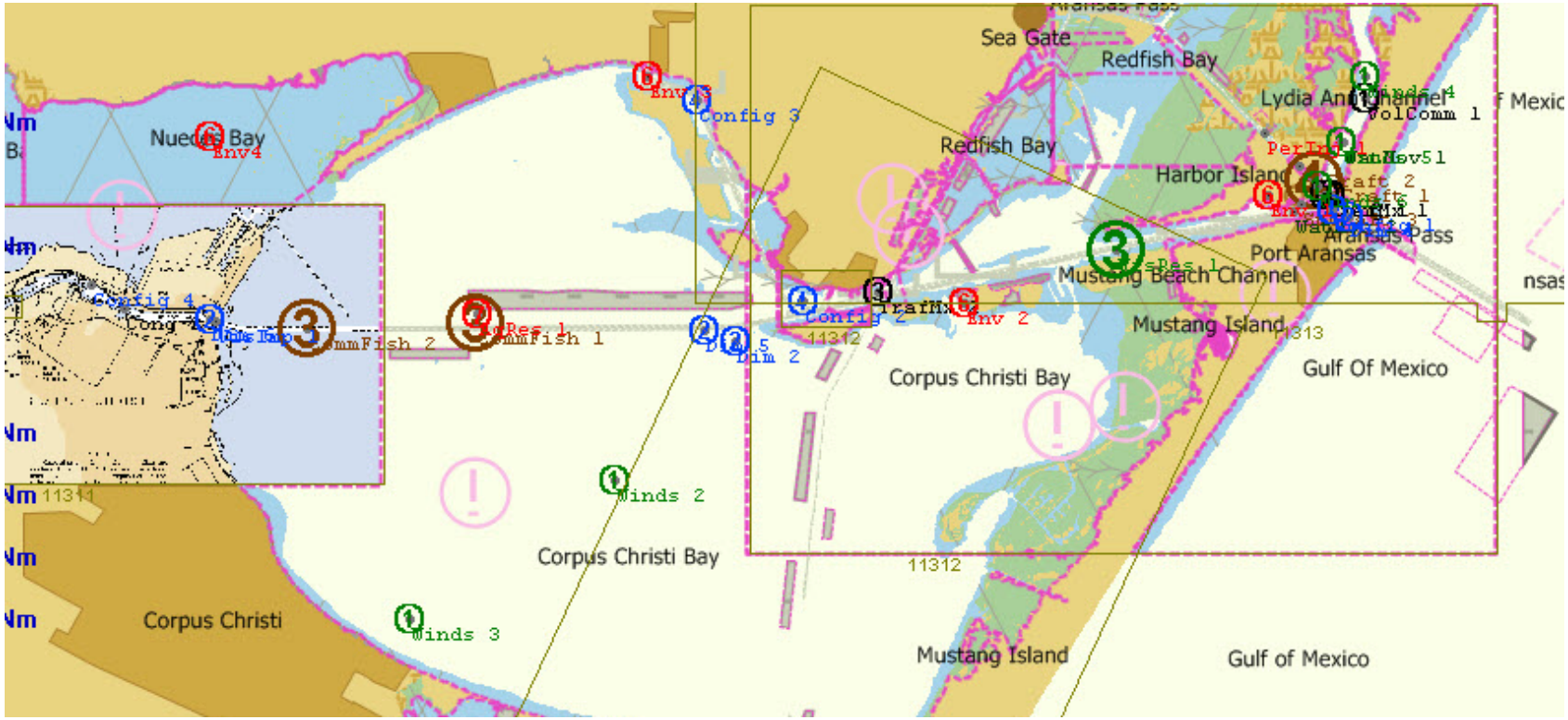

Figure 10: All Risk Factor Markers

Figure 11: Markers Indicating Risk Areas for Vessel Conditions

Figure 12: Markers Indicating Risk Areas for Traffic Conditions

Figure 13: Markers Indicating Risk Areas for Navigational Conditions

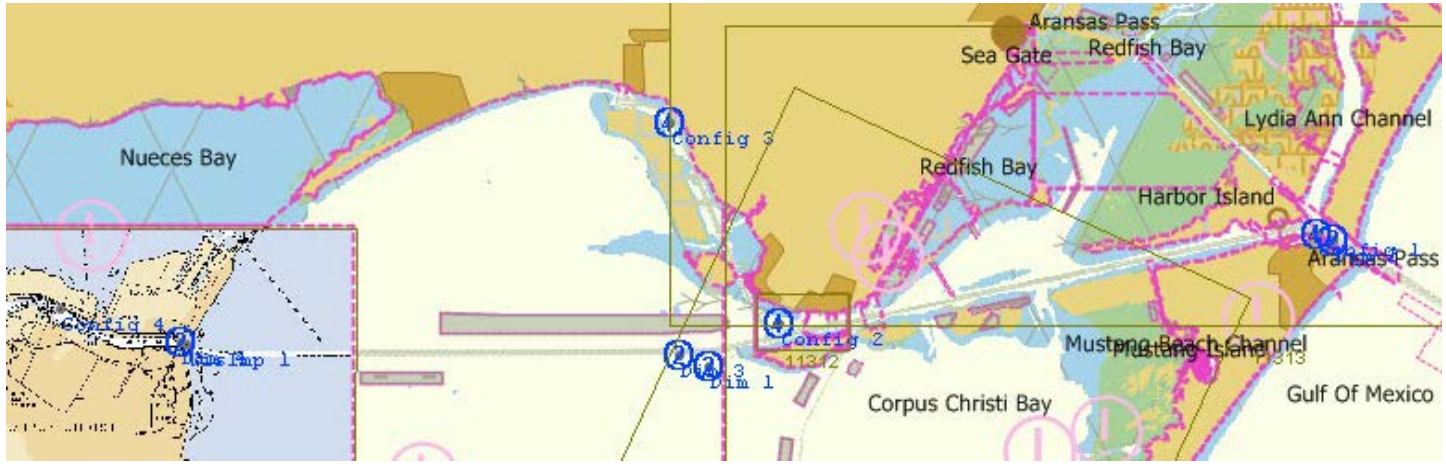

Figure 14: Markers Indicating Risk Areas for Waterway Conditions

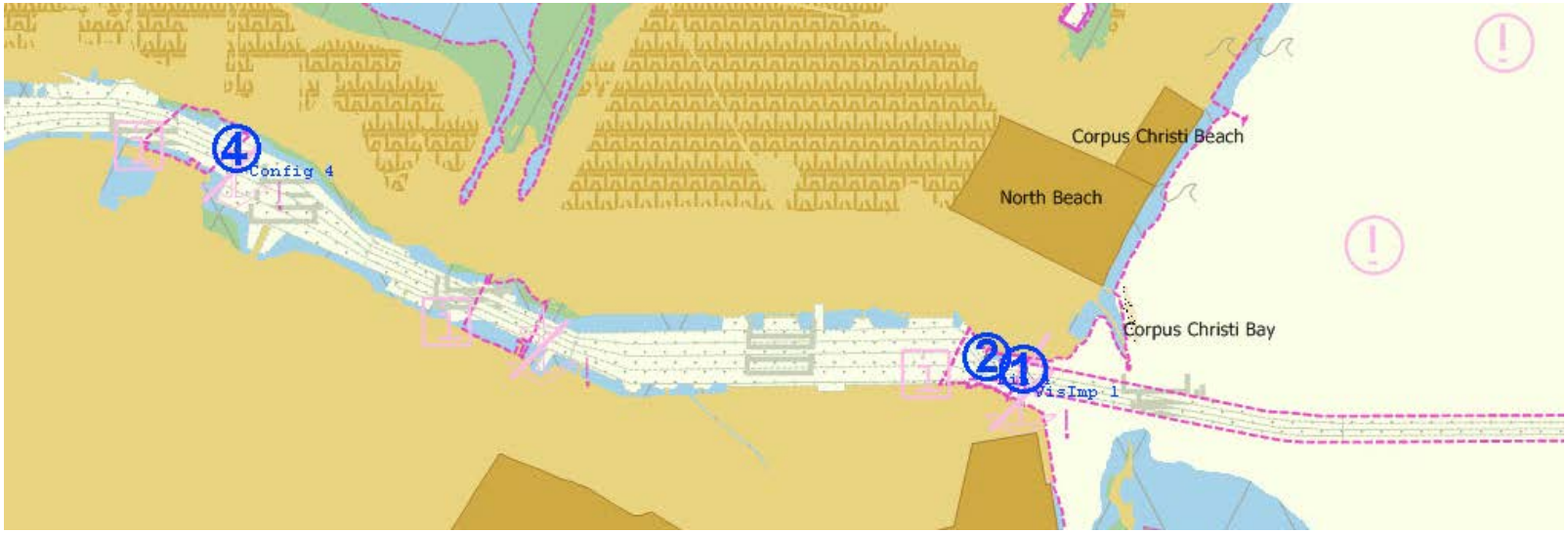

Figure 15: Markers Indicating Risk Areas for Waterway Conditions

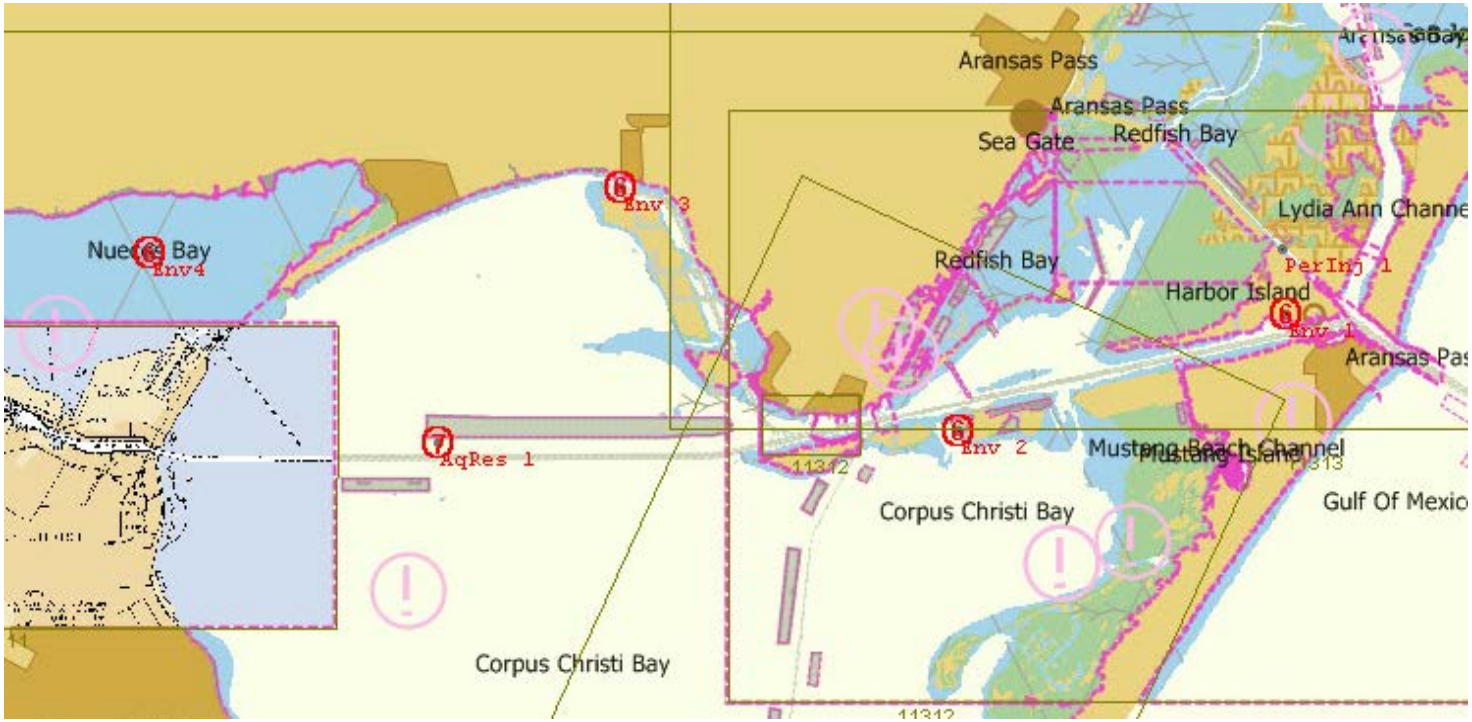

Figure 16: Markers Indicating Risk Areas for Immediate and Subsequent Consequences

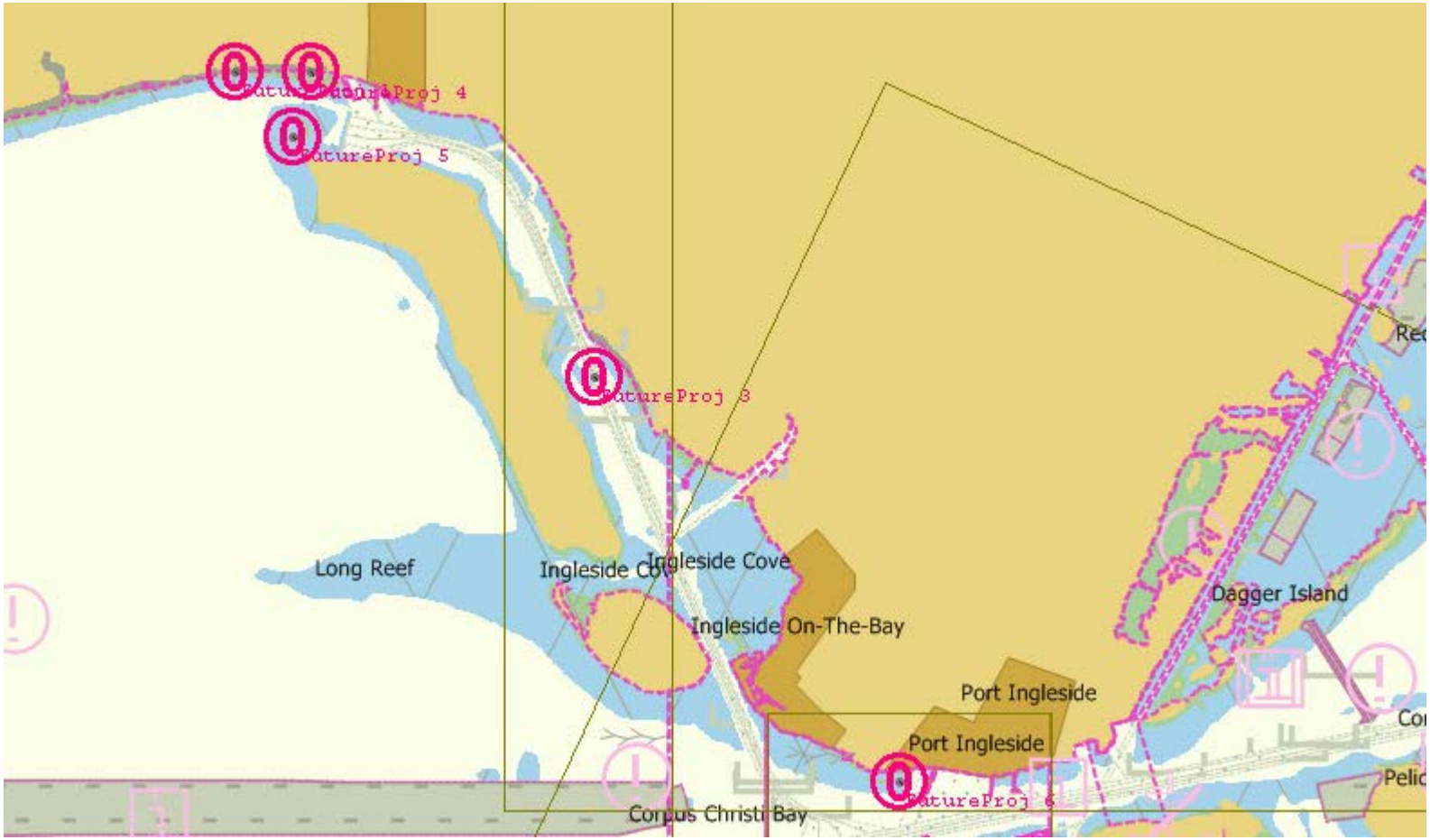

Figure 17: Markers Indicating Future Projects

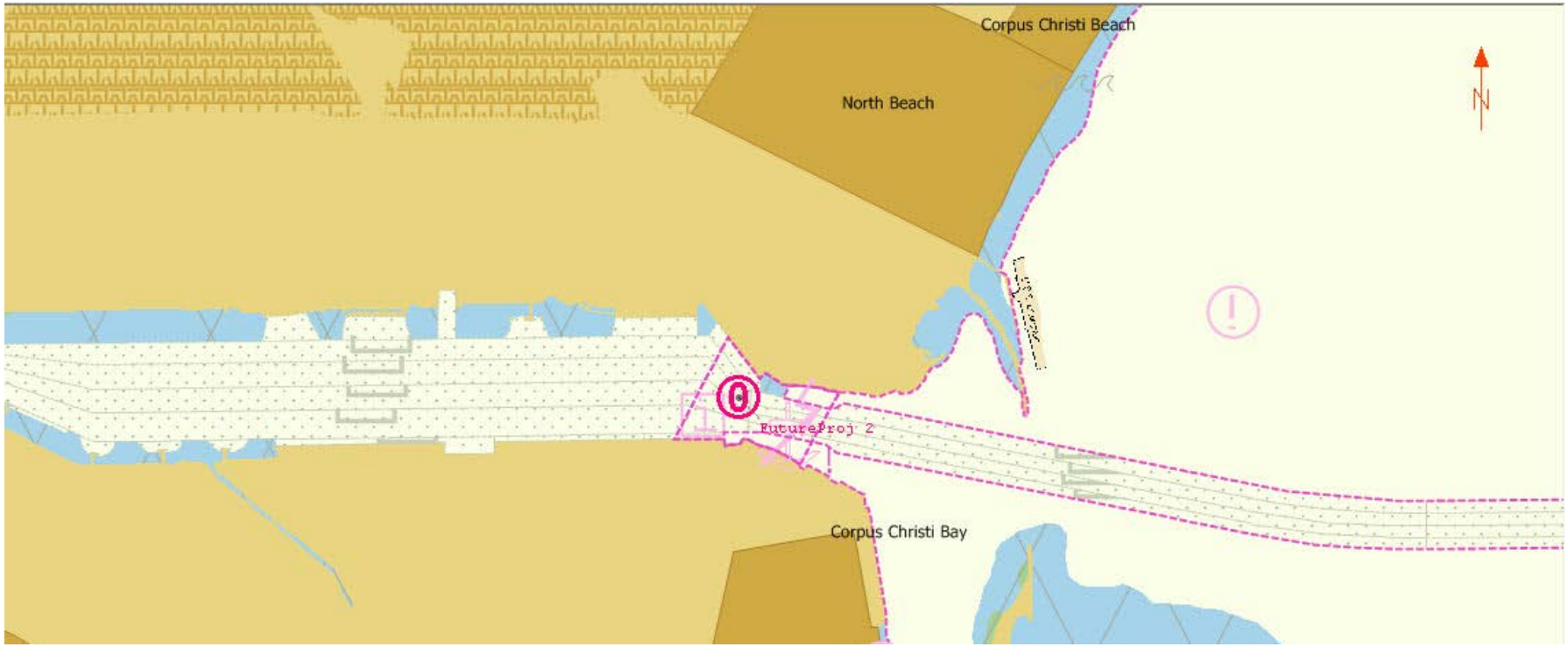

Figure 18: Marker Indicating Future Projects

Appendix F References/Guidance

	Vessel Conditions/Operations	Navigation Safety	References/Statistics
Texas Parks & Wildlife	Boat Registration https://tpwd.texas.gov/fishboat/boat/owner/titles_and_registration/	State-Specific Boating Safety Requirements https://tpwd.texas.gov/fishboat/boat/laws/index.phtml	Boating Safety Education https://tpwd.texas.gov/fishboat/boat/responsible/index.phtml
U.S. Coast Guard	46 CFR Subchapter C – Uninspected vessels 46 CFR Chapter I – Vessel Inspection requirements Electronic Code of Federal Regulations: Recreational Boating Safety - Federal Regulations Regulations	U.S. Navigation Rules Navigation Rules Online Navigation regulations by location Navigation Regulations Search Boating Safety Division Home Page	Recreational Boating Safety - Accident Statistics Statistics USCG Auxiliary –Requirements-Recreational Boats Recreational Boating Safety Information & Resources
U.S. Army Corps of Engineers	Galveston District - Regulatory Branch http://www.swg.usace.army.mil/	Galveston District -Navigation Notices http://www.swg.usace.army.mil/Missions/Navigation/NoticetoNavigation.aspx	
National Oceanic and Atmospheric Administration		National Data Buoy Center –Corpus Christi http://www.ndbc.noaa.gov/station_page.php?station=42020 National Weather Service NOAA's National Weather Service	Safe Boating Weather Tips http://www.nws.noaa.gov/om/brochures/safeboat.htm U.S. Coast Pilot 5–Gulf of Mexico http://www.nauticalcharts.noaa.gov/nsd/coastpilot_w.php?book=5

Appendix G

Waterways Management/Best Practices

Port of Corpus Christi – Official Website
http://www.portofcc.com

Port of Corpus Christi Plan for Safety and Security
http://www.portofcc.com/images/pccpdfs/PortofCorpusChristi%20StrategicPlan.Adopted%2012.10.13.pdf

Texas Parks & Wildlife
https://tpwd.texas.gov/

State of Texas Online Boating Courses
https://tpwd.texas.gov/education/boater-education/boater-education-online-courses

American Waterways Operators Foundation
The American Waterways Operators

Life Lines Brochure - Safety Tips That Could Save Your Life
http://www.americanwaterways.com/commitment_safety/lifelines.pdf

American Canoe Association
American Canoe Association

Top 10 Safety Tips for Paddlers
Top 10 Safety Tips - American Canoe Association

U.S. Coast Guard
http://www.uscg.mil/

Guidance for the Establishment/ Development of Harbor Safety Committees
http://www.uscg.mil/hq/cg5/nvic/pdf/2000/n1-00.pdf

Notices for the Boating Public
Boating Safety Circulars

British Rowing
http://www.britishrowing.org/

Incident Reporting
http://www.britishrowing.org/sites/default/files/rowsafe/4-1-IncidentReporting-v1.pdf

Port of London Authority
http://www.pla.co.uk/index.cfm

Codes of Practice:
Safe mooring of vessels
Rowing on the Tideway
Passenger vessel operations
Codes of Practice > Safety

Guidance Documents
Mariners' Guide to Bridges on the Tidal Thames
Recreational Users Guide for the tidal River Thames
Guidance Documents > Safety

Appendix H Port of Corpus Christi Ship and Barge Statistics

Ship and Barge Arrival Count

Month	2012		2013		2014		2015	
	Ships	Barges	Ships	Barges	Ships	Barges	Ships	Barges
1	100	349	116	426	113	543	147	557
2	88	302	104	375	98	395	117	481
3	116	374	120	429	125	571	142	530
4	98	350	107	391	127	532	154	466
5	110	432	125	479	137	582	155	480
6	96	426	120	419	128	569	146	478
7	123	420	131	466	150	676	154	509
8	120	430	118	479	165	625	53*	154*
9	119	413	132	438	133	618		
10	116	435	132	471	156	636		
11	107	402	123	491	131	594		
12	129	427	142	521	136	567		
Total	1322	4760	1470	5385	1599	6908	1068*	3655*
	6082		6855		8507		1222*	

*to date

Ocean Going Barge Count

January 2010 – 30 July, 2015

	2010		2011		2012		2013		2014		2015	
	Dry	Liquid	Dry	Liquid	Dry	Liquid	Dry	Liquid	Dry	Liquid	Dry	Liquid
	44	135	47	201	59	458	56	651	54	839	53*	380*
Total	179		248		517		707		893		433*	

*to date