

Ports and Waterways Safety Assessment

Workshop Report

Houston/Galveston, Texas

14 - 15 July, 2009

United States Coast Guard

Office of Waterways Management



Providing Navigation Safety Information

for America's Waterways

Ports and Waterways Safety Assessment (PAWSA)

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Introduction

The United States Coast Guard, Office of Waterways Management, is responsible for developing and implementing policies and procedures that facilitate commerce, improve safety and efficiency, and inspire dialogue with port and waterways users to make waterways as safe, efficient, and commercially viable as possible. To accomplish this objective, the Coast Guard utilizes the Ports and Waterways Safety Assessment (PAWSA) process. The long-term goals of the PAWSA process are to:

- 1) Provide input when planning for future Vessel Traffic Management (VTM) projects, including establishing or expanding existing Vessel Traffic Services (VTS),
- 2) Further the Marine Transportation System (MTS) goals of improved coordination and cooperation between government and the private sector, and involving stakeholders in decisions affecting them,
- 3) Foster development and strengthen roles of Harbor Safety Committees (HSC) within each port, and
- 4) Support and reinforce the role of Coast Guard Captains of the Port (COTP) in waterways management and vessel traffic management within their assigned geographic areas of responsibility.

Section I: History of the Ports and Waterways Safety Assessment process

The PAWSA process grew out of the tremendous changes that took place during the 1990s in the United States Coast Guard VTS acquisition program. In September 1996, at the direction of the US Congress, the Coast Guard began work to identify minimum user requirements for new VTS systems in consultation with local officials, waterways users and port authorities, and also to review private and public partnership opportunities in VTS operations. As a result of this Congressional direction, the Coast Guard established the PAWSA process to address waterway user needs and place a greater emphasis on partnerships with maritime industry experts to identify baseline risk levels and recommended solutions to further reduce risks in the marine environment.

The PAWSA risk assessment process is a disciplined approach to identify major waterway safety hazards, estimate risk levels, evaluate potential mitigation measures, and set the stage for implementation of selected risk reduction measures. The process involves convening a select group of waterway users and stakeholders and conducting a structured workshop to meet these objectives. The risk assessment process is a joint effort involving waterway users, stakeholders, and agencies responsible for implementing risk mitigation measures.

Section II: How PAWSA workshops are conducted

The PAWSA process uses a structured approach for obtaining expert judgments on the level of maritime safety risk in a port complex. The process also addresses the effectiveness of existing and possible future intervention actions for reducing risk in the specified port and waterways. The **first step** in the PAWSA process is for the participants to discuss and then numerically evaluate the baseline risk levels in the geographic area being analyzed using pre-defined qualitative risk descriptions for 24 pre-defined risk factors. The **second step** is for the participants 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 process. In the **third step**, the participants discuss and then evaluate the risk reducing effectiveness of existing mitigation strategies. Next, the participants offer new ideas for further reducing risk, for those factors where risk is judged to be not well balanced with existing mitigations. **Finally**, the potential effectiveness of those new intervention ideas is evaluated. The PAWSA process produces a consensus view of risks in the port and waterways and has proven to be an excellent tool for focusing follow-on risk mitigation efforts.

Section III: Explanation of the PAWSA Waterway Risk Model

The Waterway Risk Model includes variables dealing with both the causes of waterway casualties and their consequences. In the Port 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 the effects of vessel casualties.

The six risk categories used in the model are:

1. **Vessel Conditions** – the quality of vessels and their crews that operate on a waterway.
2. **Traffic Conditions** – the number of vessels that use a waterway and their interactions.
3. **Navigational Conditions** – the environmental conditions that vessels must deal with in a waterway relating to wind, water movement (i.e., currents), and weather.
4. **Waterway Conditions** – the physical properties of the waterway that affect how easy it is to maneuver a vessel.
5. **Immediate Consequences** – the immediate impacts of a waterway casualty: people can be injured or killed, petroleum and hazardous materials can be spilled and require response resources, and the marine transportation system can be disrupted.
6. **Subsequent Consequences** – the subsequent effects of waterway casualties that are felt hours, days, months, and even years afterwards, such as shore side facility shut-downs, loss of employment, destruction of fishing areas, decrease or extinction of species, degradation of subsistence living uses, and contamination of drinking or cooling water supplies.

Figure 1

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

Section IV: Houston/Galveston PAWSA - geographic areas assessed

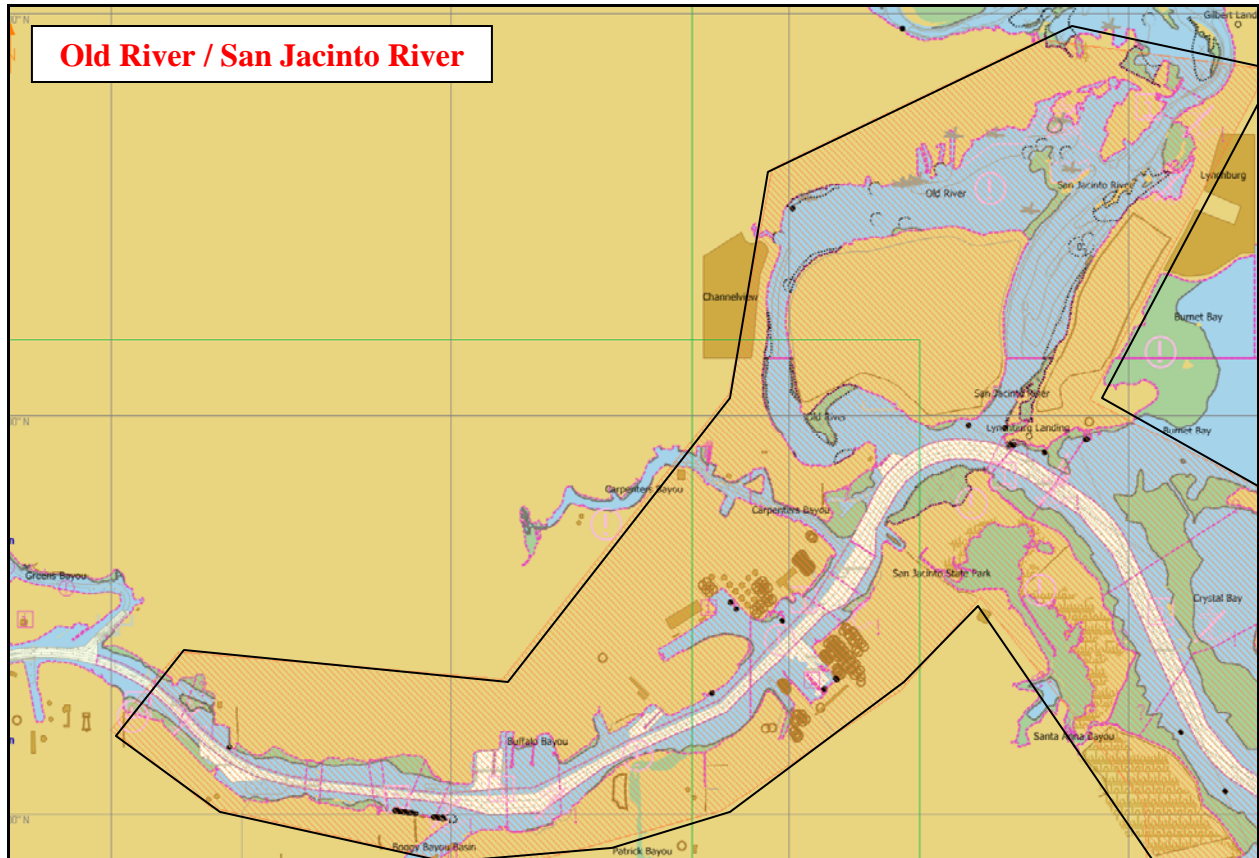
In support of overall safety improvement activities, a formal PAWSA for Houston Ship Channel (HSC) and adjacent waters was conducted in Houston, Texas on 14-15 July 2009. The workshop was attended by 19 participants representing waterway users, regulatory authorities, stakeholders, and organizations with an interest in the safe and efficient use of Houston Ship Channel, Galveston Approaches, and the Intracoastal Waterway, from both a commercial and recreational user perspective. A list of the workshop participants, observers, and the workshop facilitation team is included as appendix A to this report

This report outlines the baseline risk levels within each specific geographic area, captures workshop participant provided input regarding current operations and trends, and describes existing mitigation strategies that serve to “balance” the risks associated with each of the 24 risk factors in the Waterways Risk Model. For those waterway risk factors where risk is judged to be not well balanced with existing mitigations, this report also contains new ideas for further reducing risks.

Three separate geographic areas within the port of Houston / Galveston were assessed during the workshop.

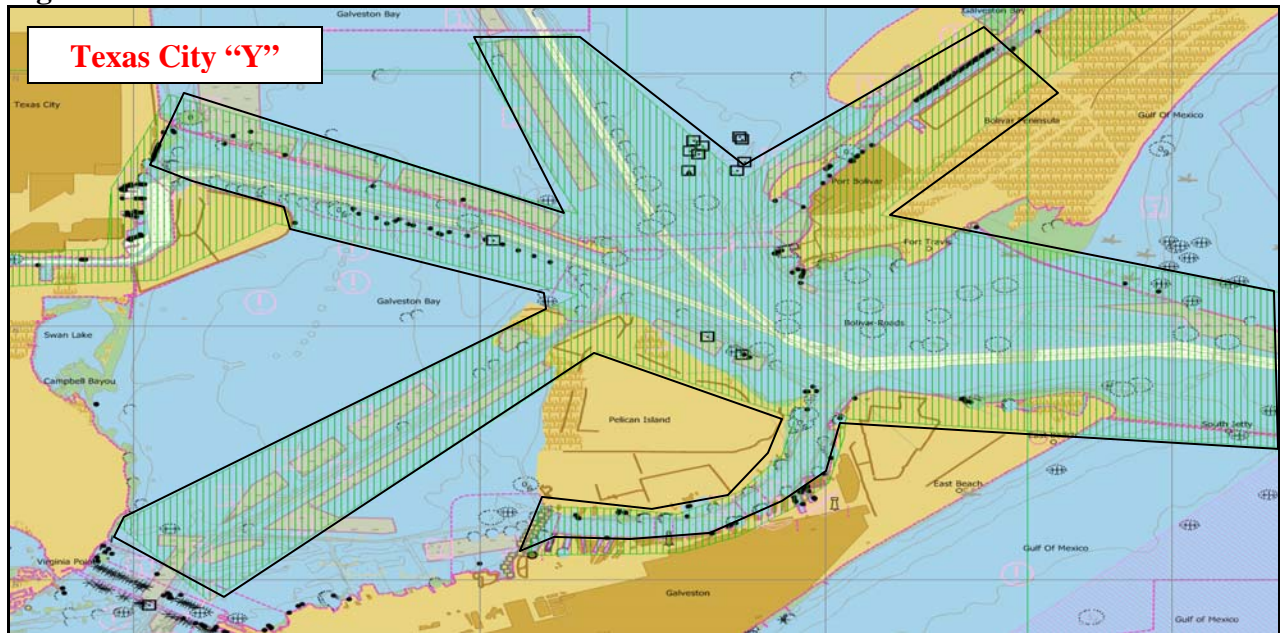
- ▶ Old River / San Jacinto River / Lynchburg— This includes the lower reaches of Carpenters Bayou and adjacent barge fleeting areas. This area also takes in the Old River and San Jacinto River from their confluences with the Houston Ship Channel upstream to the I-10 Highway Bridge.

Figure 2



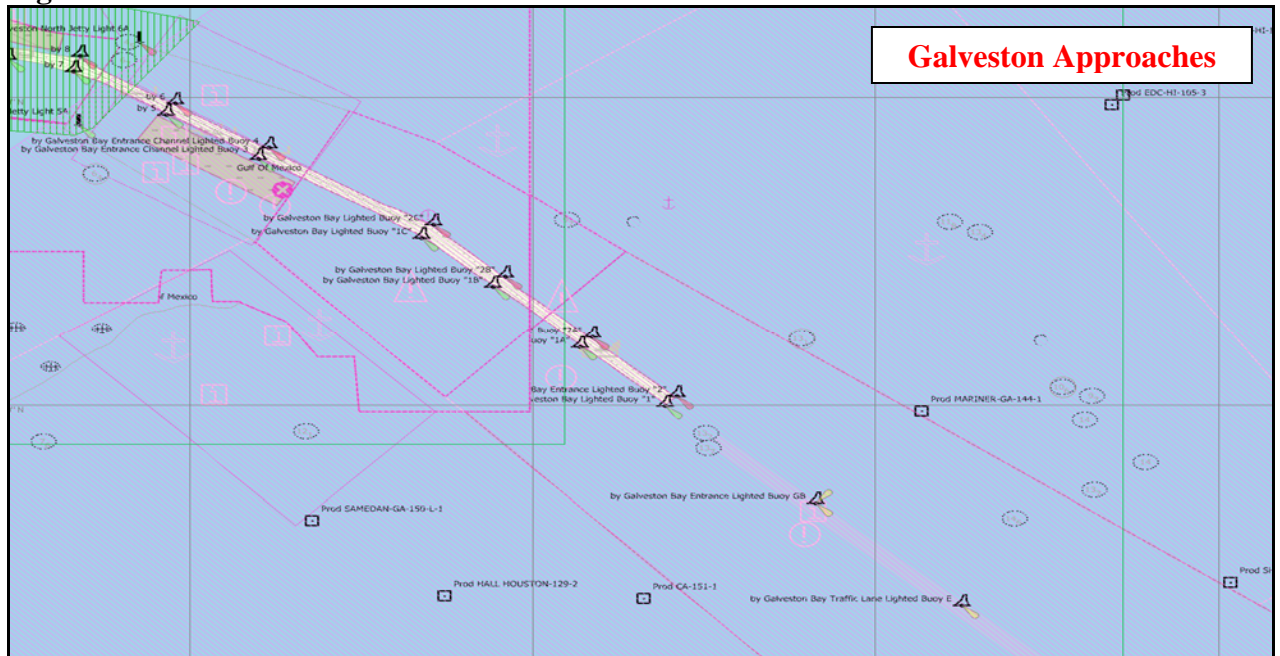
- ▶ Texas City “Y” – This includes the Houston Ship Channel starting at the Galveston Jetties to Red Fish Island, Texas City Ship Channel, and the Intracoastal Waterway (ICW) from just east of the I-45 Causeway Bridge to mile marker 333 on the ICW.¹

Figure 3



- ▶ Galveston Approaches – This includes the Galveston Fairway Anchorages and the approach channel seaward to the Galveston seabuoy (“GB”).

Figure 4



¹- Impending construction work to replace the Galveston Railway Bridge will result in a significant increase in barge traffic in the area of the bridge; GIWW traffic disruptions; and increased pressure on already limited barge moorings in Pelican Cut (the only sheltered mooring area east of Greens Lake MM364). Each of these factors add to pre-existing rationale for extension of the VTSA westward to the vicinity of MM 359/Red Can Bend.

Two additional areas were discussed during the workshop, but were not subject to the full PAWSA risk assessment process. These areas may be the subject of future PAWSA workshops. These areas were:

► **Figure 5** - Bayport Channel – From the Houston Ship Channel to the Bayport Turning Basin.²

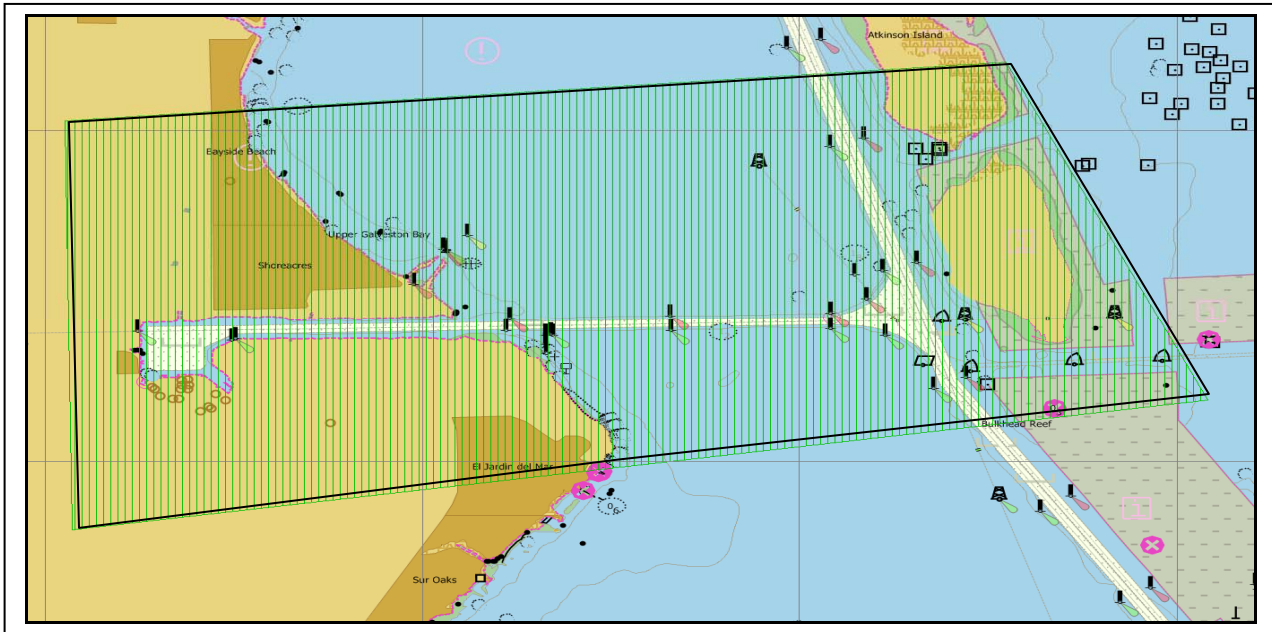
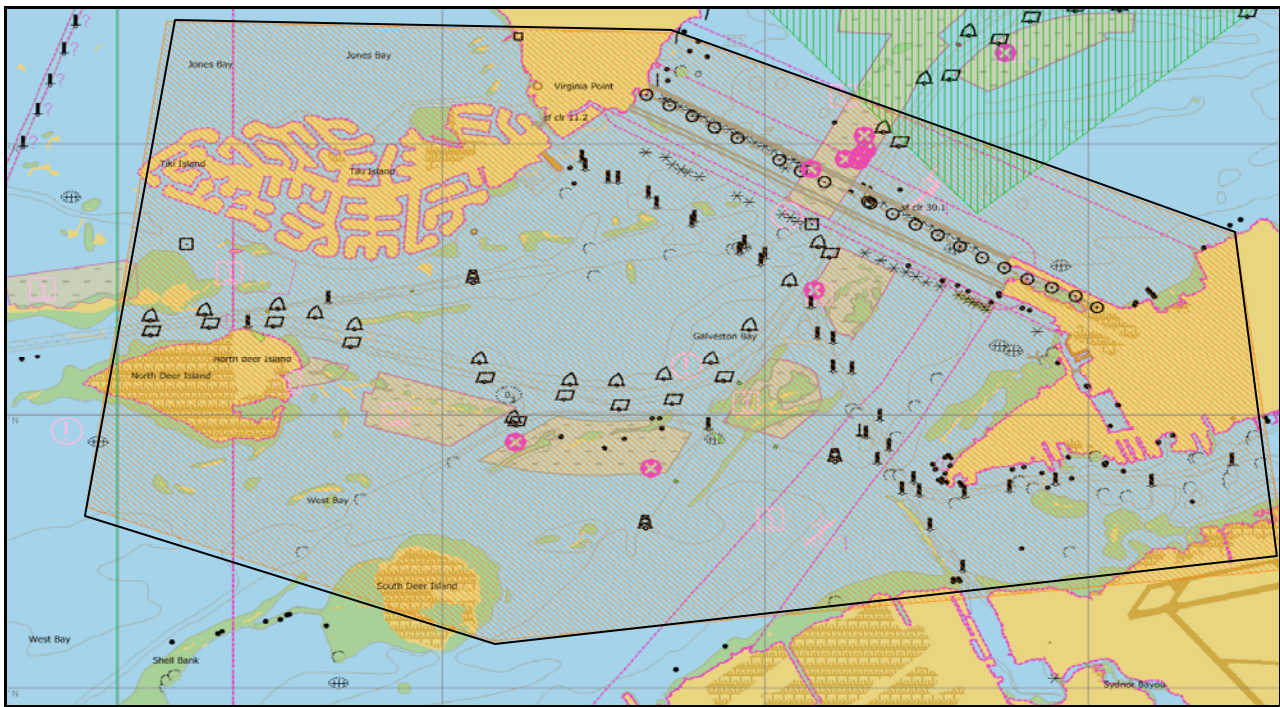


Figure 6 - I-45 Causeway / Galveston Railway Bridge³



² The Houston Pilots have received requests to bring 1100' x 164' container ships into Bayport. While Bayport was excluded from this PAWSA, it was worth noting that these container ships will transit the entrance channel, Texas City Y, and the narrow Houston Ship Channel.

³ Refer to footnote 1 at page 4

Section V: Book 1 – Establishing baseline risk levels

Book 1 was used to determine a risk level value for every factor in the Waterway Risk Model. To establish baseline risks in the port, the workshop participants discussed each of the 24 risk factors on the Waterways Risk Model. The following are noteworthy observations and comments made by the workshop participants. Additional participant observations, trends and comments points are included as appendix B to this report.

Deep Draft Vessel Quality: Chemical tank ships are the highest quality of blue water vessels coming into Houston. Intensive in-house training programs helps to maintain high quality crews. Houston's blue water vessel quality is good compared to other areas of the world. Issues are discussed and are often sorted out during Houston-Galveston Navigation Safety Advisory Committee (HOGANSAC) ⁴ meetings.

Commercial Fishing Vessel Quality: Vietnamese language is prevalent with shrimp and oyster boats (dredging oysters) and English language skills are often lacking and sometimes appear to be nonexistent. Shrimp season opens in mid-July, wherein they work in evening and sleep in day.

Small Craft Quality: There have been many new recreational boats in the last year despite the economic recession, probably replacements of boats destroyed by Hurricane Ike.

Volume: This is the second largest chemical tanker port in world. A tanker may come in for two weeks and visit up to seven docks. About 2,000 barges are within the HSC transportation system at any given time.

Winds: Fleeting areas can fill up with barges quickly due to unfavorable winds from the north causing a drop in the channel depth.

Water Movement: Not as robust and survivable as they could be, but when up and working, the National Oceanographic and Atmospheric Administrations' (NOAA) Physical Oceanographic Real-Time System (PORTS) buoys are highly advantageous.

Visibility Restrictions: The VTS identifies / communicates water conditions important to the maritime community. Communication on the waterway is good. :

Visibility Impediments: This is the most challenging port in North America in terms of light pollution, making it difficult to see navigational aids.

Use of an Electronic Chart System (ECS) to identify high risk areas

As the workshop participants discussed and identified specific locations associated with a particular risk factor, an Electronic Charting System (ECS) was utilized by the workshop facilitation staff to identify the specific geographic areas associated with the risks, and then annotate the ECS with the location. Appendix C includes ECS information/chart extracts showing the risk factor types/locations identified by the workshop participants.

⁴The Houston/Galveston Navigation Safety Advisory Committee (HOGANSAC) provides advice and consultation to the Commandant of the Coast Guard on matters relating to the transit of vessels and products to and from the ports of Galveston, Houston and Texas City, and through Galveston Bay. The Committee reports to the Commander of the Eighth Coast Guard District, who is the sponsor of the Committee, and the Captain of the Port Houston-Galveston, who is the Executive Director of the Committee. HOGANSAC has not only been a very valuable source of expert advice, it has been a hands-on, extremely productive group, directly assisting the Coast Guard in its efforts to ensure safe marine transportation in the Houston-Galveston-Texas City port complexes. HOGANSAC's 19 members include a wide-spectrum of waterway users. Pilots associations, shallow draft interests, deep draft operators, environmental and academic interests are all represented. For more information on HOGANSAC, please visit <http://homeport.uscg.mil/mycg/portal/ep/home.do> and select the Ports and Waterways link. HOGANSAC information is located in the Safety Advisory Committee section.

The participants evaluated the baseline risk levels in the waterway by selecting a qualitative description for each risk factor that best described conditions in the Houston Ship Channel. Those qualitative descriptions were converted to discrete values using numerical scales that were developed during earlier PAWSAs. 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 7

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
4.0	8.7	3.1	7.5	7.3	8.7
Shallow Draft Vessel Quality	Volume of Small Craft Traffic	Water Movement	Dimensions	Petroleum Discharge	Environmental
5.0	4.3	4.2	8.3	9.0	5.3
Commercial Fishing Vessel Quality	Traffic Mix	Visibility Restrictions	Bottom Type	Hazardous Materials Release	Aquatic Resources
8.4	7.0	3.4	2.7	8.7	6.9
Small Craft Quality	Congestion	Obstructions	Configuration	Mobility	Economic
4.6	6.9	5.0	8.4	8.5	9.0

In the Houston-Galveston PAWSA, 17 of the 24 risk factors were scored at or above the mid-risk value. Risk values highlighted red (values at or above 7.7) denote very high baseline risk levels; risk values highlighted green (values at or below 2.3) denote very low baseline risk levels. Since there were no values measured at or below 2.3, none of the risk factors were highlighted green.

- Economic (9.0)
- Hazardous Materials Release (8.7)
- Health and Safety (8.7)
- Configuration (8.4)
- Dimensions (8.3)
- Personnel Injuries (7.3)
- Congestion (6.9)
- Environmental (5.3)
- Shallow Draft Vessel Quality (5.0)
- Petroleum Discharge (9.0)
- Volume of Commercial Traffic (8.7)
- Mobility (8.5)
- Fishing Vessel Quality (8.4)
- Visibility Impediments (7.5)
- Traffic Mix (7.0)
- Aquatic Resources (6.9)
- Obstructions (5.0)

Section VI: Book 2 - Participant / Team expertise cross-assessment

Book 2 is used to capture the expertise level of each team relative to one another. PAWSA workshop participants are expected to have varying expertise with respect to the risk categories in the Waterway Risk Model. Book 2, *Team Expertise*, is used early in the session to weigh the relative strengths of each team with respect to the six risk categories. After being presented with the concepts underlying the model, each participant team is asked to discuss (among themselves) how their background and experience aligns with the model. They then verbally present their conclusions to the larger group. This presentation gives all teams a sense of where everyone thinks they are strong – or perhaps not so strong. After all teams have spoken, each team evaluates whether they think they are in the top, middle, or lower third of all teams present in knowledge about the six risk category areas. Throughout the workshop, these preliminary expertise evaluations are used to produce preliminary results for all other Books.

The workshop participants assessed their own and all the other participant teams' level of expertise for each of the six categories in the Waterway Risk Model. Overall, 46% of the participant teams were placed in the upper third, 32% in the middle third, and 22% 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 where strong for all categories.

The expertise ranking for each team was used to weight the inputs that each team provided in the other three books used during the PAWSA workshop. The following table further breaks down the participants' expertise per risk category.

Figure 8

Team Expertise -- Distribution

Risk Category	Top 1/3	Mid 1/3	Lower 1/3
Vessel Conditions	38%	36%	26%
Traffic Conditions	60%	20%	20%
Navigational Conditions	44%	38%	17%
Waterway Conditions	47%	35%	19%
Immediate Consequences	51%	30%	20%
Subsequent Consequences	33%	36%	31%
All Categories Average	46%	32%	22%

Section VII: Book 3 – Evaluating the effectiveness of existing risk mitigation strategies

Book 3 was used to evaluate the effectiveness of existing mitigation strategies in reducing the risk level for each factor in the model. In book 3, the workshop participants reviewed the effectiveness of existing risk mitigations with respect to all risk factors in the Waterway Risk Model. For 16 risk factors, there was consensus that risks were well balanced by existing mitigations; for 3 risk factors there was consensus that risks were NOT adequately balanced by existing mitigations; and for the other 5 risk factors there was no consensus on whether existing mitigations adequately reduced risk. Consensus is defined as 2/3 of the workshop participants being in agreement.

Figure 9

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	
4.0	2.6	8.7	4.6	3.1	2.1	7.5	5.0	7.3	4.6	8.7	5.6
Balanced		Balanced		Balanced		NO		Balanced		Balanced	
Shallow Draft Vessel Quality		Volume of Small Craft Traffic		Water Movement		Dimensions		Petroleum Discharge		Environmental	
5.0	3.2	4.3	2.9	4.2	3.1	8.3	5.6	9.0	5.4	5.3	3.3
Maybe		Balanced		Balanced		Balanced		Balanced		Balanced	
Commercial Fishing Vessel Quality		Traffic Mix		Visibility Restrictions		Bottom Type		Hazardous Materials Release		Aquatic Resources	
8.4	6.7	7.0	5.1	3.4	2.4	2.7	1.9	8.7	5.6	6.9	3.8
NO		Maybe		Balanced		Balanced		Balanced		Balanced	
Small Craft Quality		Congestion		Obstructions		Configuration		Mobility		Economic	
4.6	2.9	6.9	4.9	5.0	2.7	8.4	5.6	8.5	5.8	9.0	6.4
Balanced		Maybe		Balanced		Maybe		Maybe		NO	

KEY	
Risk Factor	
Book 1	Book 3
Consensus	

EXPLANATION	
Book 3	Baseline level of risk
Book 4	Level of risk taking into account existing mitigations
Balanced	Consensus that risks are well balanced by existing mitigations
Maybe	No consensus that risks are adequately balanced by existing mitigations
Rising	No consensus that risks are adequately balanced by existing mitigations and the mitigated risk level either is higher than the result from a previous PAWSA or is higher than the baseline risk level from this PAWSA
NO	Consensus that existing mitigations do NOT adequately balance risk

Section VIII: Book 4 – Identifying additional risk mitigation strategies

The workshop participants next completed book 4, which evaluated how successfully a proposed risk mitigation/intervention strategy would be at lowering risk levels for each of the 8 waterways risk factors that were determined to require additional intervention actions. The table below shows the expected reduction in risk when taking the actions recommended by the workshop participants. A green **Balanced** indicates that no intervention is needed because risk in the waterway was judged to be well balanced by existing mitigations. A yellow **Caution** indicates that there was a difference between the most effective general strategy and the general strategy most selected by the workshop participants.

Figure 10

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	Balanced	Balanced	Waterway Changes 4.7	Balanced	Balanced
Shallow Draft Vessel Quality	Volume of Small Craft Traffic	Water Movement	Dimensions	Petroleum Discharge	Environmental
Coordination / Planning 2.9	Balanced	Balanced	Balanced	Balanced	Balanced
Commercial Fishing Vessel Quality	Traffic Mix	Visibility Restrictions	Bottom Type	Hazardous Materials Release	Aquatic Resources
Enforcement 6.5	Voluntary Training 4.7	Balanced	Balanced	Balanced	Balanced
Small Craft Quality	Congestion	Obstructions	Configuration	Mobility	Economic
Balanced	Coordination / Planning 4.4	Balanced	Coordination / Planning 4.2	Coordination / Planning 2.7	Coordination / Planning 3.2 Caution

KEY		EXPLANATION	
Risk Factor		Intervention	Intervention general strategy that most participants selected for further risk mitigating actions
Intervention		Risk Improvement	The amount that present risk levels might be reduced if new mitigation measures were implemented
Risk Improvement	Caution	Caution	No consensus alert

The workshop participants judged that additional risk reduction actions were needed with respect to 8 of the 24 risk factors in the Waterway Risk Model. The table below summarizes that information and is arranged from highest to lowest possible risk improvement. A description of each risk mitigation general strategy is included in appendix D.

Risk Factor	General Strategy	Specific Actions
Economic	Coordination/Planning	Allow flexibility for private industry to resolve the reduced functionality required for their purposes and economic survival.
Mobility	Coordination/Planning	Develop plan to address a completely blocked channel – Cooperative Business Continuity Plan; workflow and responsibilities required for contingencies such as Army Corps dredging a new channel or other alternatives to reopen the channel.
Active Traffic Management	Coordination/Planning	Expand the VTS Area to include existing fleeting area near the San Jacinto and Old River north to the I-10 Highway Bridge, Offshore Galveston Approach, Intracoastal Waterway from MM338 to Red Can Bend MM359 . Mitigate all crossings in the ‘Y’ and elsewhere.
Congestion	Coordination/Planning	Develop a “Common Passage Plan for the Houston-Galveston Ports and Waterways.”
Traffic Mix	Voluntary Training	Awareness training regarding how vessels interact and need to work with each other.
Visibility Impediments	Waterway Changes	Improve the navigational lighting; add more super ranges; ensure illumination of selected day boards.
Shallow Draft Vessel Quality	Coordination/Planning	Improve awareness of the charterers that will be using the charter vessel (Wire boats / non-rigid composite tug and tow) category so they fully understand the vessel limitations and impacts on other port users.
Commercial Fishing Vessel Quality	Enforcement	Additional resources to assist communicating and enforcing regulatory compliance.

The specific actions listed are the ones most recommended within the general strategy recommended by the workshop participants. Appendix E is the complete list of all additional risk mitigations strategies identified by the workshop participants.

Conclusion

The ultimate goal of a PAWSA is to not only to establish a baseline of waterways for VTS consideration, but to provide the Coast Guard Sector Commander 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. This report supports these goals, and should be viewed as a starting point for continuing dialogue within the local maritime community.

The United States Coast Guard, Office of Waterways Management, extends a sincere appreciation to the workshop participants for their contributions to the PAWSA workshop. Their expertise was critical to the success of the workshop, and their recommendations will greatly assist the U.S. Coast Guard as it continues to work with the maritime community to further improve safety and efficiency in the Port of Houston/Galveston.

Appendix A

Houston/Galveston PAWSA workshop - Attendee list

Participants:	Organization	Email Address
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Captain Joe Hill	Valero	Joe.Hill@valero.com
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Mr. Philip Kropf	Non-VTS Users	pkropf@flash.net
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Facilitation Team:	Organization	Email Address
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Appendix B

Workshop Participants - Observations, Trends and Existing Mitigations

Deep Draft Vessel Quality

Today:

- *Chemical tank ships are the highest quality of deep draft vessels coming into Houston.*
- Tank ships are often 15 years old or less.
- The tank barge business requires new and more modern equipment. Tank ships and tank barges are held to a higher standard.
- Tankers are almost always double-hold tankers.
- Vessel vetting by oil/petroleum companies are ensuring a high quality tank ship and tank barges transiting the Houston Ship Channel.
- *Intensive in-house training programs helps to maintain high quality crews.*
- Some older tankers are able to transition into less sensitive roles, such as transporting edible oils, so they can continue to be of service safely with relatively lower vessel quality.
- Pilots have a historical cultural background for standards of proficiency.
- Older ships are being seen in Houston. From a pilot's perspective, age really takes its toll on vessels.
- *Houston's deep draft vessel quality is good compared to other areas of the world.*
- Older and more poorly maintained vessels attract lower quality crews and lower quality crews do not bunker as quickly, have more spills on deck, and similar issues.
- Reporting has become more robust and therefore differences between yearly statistics may be undeservedly negative.
- Fuel oil quality or switching to or from sea fuel prematurely can cause problems.
- Number of casualties should be understood in proportion to number of transits.

Trends:

- Single hold tankers are becoming ever more rare.
- Tank barge crew quality is dropping because quality of life on ships has decreased while training and licensing requirements are increasing.
- It is becoming more difficult to get high quality experienced crews.

Existing Mitigations:

- Control programs run by the Coast Guard reduce risk.
- In chemical tanker industry, "owned and operated" vessels have employees that work directly for the company, causing a sense of responsibility, which is a big factor in upkeep and safety.
- Port State Control reduces risk.
- Good pilots reduce risk.
- Barge lanes reduce risk.
- Vessel Traffic Service (VTS) communications reduces risk.
- There is close port coordination on vessel movements.
- Additional pilot rules reduce risk.
- Pilots will impose restrictions on a vessel beyond general technical requirements, for example, because of handling characteristics.

- Tug force power matrix – tug requirements for ship movements – reduces risk.
- The industry vetting is ensuring that most ships are fairly high quality.
- Pilots and Coast Guard have open lines of communication, such as through the Port Communication Team.
- Good port partnership and working relationships reduces risk.
- Issues are discussed and are often sorted out during Houston-Galveston Navigation Safety Advisory Committee (HOGANSAC) meetings at the subcommittee level.
- The chemical and petroleum industry has fairly stringent safety criteria imposed on owners.
- The barge business is very critical of overage barges. Fifteen years is an industry-wide cutoff.
- Incident follow-up is very aggressive among terminal owners and some ship owners.
- There are forms in place for robust incident follow-up.
- Many parties to the problems have ownership in the problems, which makes them proactive in preventing problems before they emerge.
- Often an experienced third-party contractor is onboard during the entire turnaround of the ship to give an unbiased review of the ship, including crew performance.

Shallow Draft Vessel Quality

Today:

- Shallow draft vessels include barges, brown water tow boats, and ferries.
- Older tow boats and barges are employed in freight / construction.
- Freight / dry bulk barges are generally not as new and modern as tank barges.
- There is a reversal of this trend in the deep sea light draft vessels of the smaller wire boat industry. Sometimes new barges are being built with more tonnage than older tugs are designed to deal with. Handling and horsepower is generally not as good.
- With turnover of older mariners, experience range is close to ten years.
- More educated crews are now coming out of maritime academies.
- Though still an issue, brown water crew fatigue is becoming less of an issue.
- The “can-do” attitude of some shallow draft vessel crews can be problematic when it ignores safety, similar to the internal dynamic experienced by the Coast Guard.
- Crews in this area are fairly regular. Occasional crews come in from far away with communication issues.
- There is a mix of regular and non-regular callers in the tow boat industry, but mostly regular callers.
- On the petroleum and chemical side, information sharing is robust and what is considered a casualty is much finer than in the past.
- Tug boats are slightly different within this group. They are built to a different standard. Horsepower and capacity has increased. Expensive and complex machinery is more prevalent than in other groups. There is a higher failure rate such as starter failure, and therefore exposure to risk, due to more cycles of stops and starting. A comparison between vessels is “like comparing apples and oranges” unless how the vessel operates is considered.
- New set of problems due to increase in capability of tug boats (i.e., horsepower increase). Ships being serviced by these newer harbor tugs are now having more mooring tackle failures than in the past due to technological advancement and horsepower increases.
- Tugs are more heavy duty than ships being tugged, so light ships’ bits and chawks / shocks cannot handle the stress.
- Independent operators chartered out to other companies are often not in very good condition. Tow boats working the freight / dry bulk or fleeting industry may only meet the Coast Guard’s minimum safety standards and may not be vetted by the larger petrochemical operators.

Trends:

- In the late 1970s and early 1980s very little training was done, and today there are far more formal training programs for the towing and tug industry.
- In 1996 it was not unusual to see 3 people per boat with 20+ years experience, whereas now 20, 10, or even 1 year of experience is more prevalent. Trend continues but not apparently to a dangerous level.
- Trend exists for more educated and less experienced mariners.
- Training programs have been ramped up to a point where saturation of trained personnel may be seen shortly.
- Serious ongoing culture change of brown water crews in terms of limiting fatigue will probably take another two generations before 50% of the issue is under control.
- Ratio of horsepower to tonnage in the tank barge area is growing and these vessels are probably replacing vessels that are now being used more in the freight / dry bulk areas.
- Large improvements are being made in towing vessels and barges.

Existing Mitigations:

- Existing mitigations for Shallow Draft Vessel Quality is mostly the same as for Deep Draft Vessel Quality.
- Towing vessels are trying to get in line with anticipated proposed rules which will increase the safety standards for these vessels.
- The trend for large improvements in towing vessels and barges reduces risk.
- Audits are required for contracted companies as often as for member companies.
- Houston has a tight maritime community.

Commercial Fishing Vessel Quality

Today:

- Language issues exist. *Vietnamese language is prevalent with shrimp and oyster boats (dredging oysters) and English language skills are often lacking and sometimes appear to be nonexistent.* One English speaker is required on each boat, but actual English language skills are sometimes suspected to be higher or lower than apparent or required skills.
- Pilots and recreational vessels also run into language issues occasionally.
- Fishing boats are in designated barge lanes where tow boats need to be running.
- Getting someone on the radio on a fishing vessel is often difficult.
- No stand-by on VHF frequency. It is hard to establish off-shore communications with fishing vessels in approach channel.
- Typically lookouts are not posted on commercial fishing vessels.
- All hands often work on the back deck and the wheelhouse is unattended when hauling nets or equipment. The only way to get their attention is to blow the ship's horn.
- Operational knowledge is mostly unknown. They are presumed to know what they're doing but appear not to care what others around them are doing.
- Fishing vessels work around the clock sometimes. *Shrimp season opens in mid-July, wherein they work in evening and sleep in day.* Crew fatigue is presumably much more serious for fishing vessels than for many other vessel types.
- Vessels are not in good condition. The work is seasonal and the bottom line seems to determine activities. Physical vessel quality seems to depend on whether good money is being made. Competition is fierce.
- Fishing vessels may travel to Mexico for cheaper fuel. This suggests operating on the margin, which raises general concerns about vessel quality.

Trends:

- There are fewer fishing vessels because of Hurricane Ike, but Hurricane Ike also churned up waters resulting in a resurgence of certain species of shrimp, which will in turn probably cause a resurgence of fishing vessels.

Existing Mitigations:

- HOGANSAC has an initiative to reach out through Galveston pilots, though results may be difficult.
- Fishing vessels have been improving their running lights / navigational lights so they can be seen at night.
- Pilots try to assist captains making their approach towards fishing vessels.
- The Coast Guard Fishing Vessel Coordinator is working hard to assist the fishing fleet in improving the quality of vessels and that they meet the minimum safety standards.
- Basic safety standards that all vessels have to meet are being applied to fishing vessels.

Small Craft Quality**Today:**

- *There have been many new recreational boats in the last year despite the economic recession, probably replacements of boats destroyed by Hurricane Ike.*
- Quality of small craft is sometimes terrible, but overall generally good.
- Crew skill level is relatively high among small craft, but sometimes there is an irresponsible attitude among recreational crews.
- Security tools often produce safety effects and safety tools often produce security effects.
- The ICW is an area of concern for recreational boaters.
- Sailboat safety around Galveston Railroad Bridge is very poor.
- At most, maybe three-quarters of recreational boats, do not come into the ship channel.
- Sometimes small craft anchor right at the edge of the ICW channel.
- Recreational boaters often do not understand the restrictions of larger vessels.

Trends:

- Improvement have been made over the last ten years due to an increase in interest in educating recreational boaters, but there are so many recreational boaters that there's a long way to go.

Existing Mitigations:

- Training is primarily through experience and osmosis so mitigation is limited.
- Education is helpful including that recreational boaters in the area do not have to stay inside the ship channel or its margins.
- Physical location and perceived danger of being near large vessels is mostly keeping small craft out of the channel.
- Many small craft concentrate behind Redfish Island, out of the channel.
- Good port partnership reduces risk.
- Auxiliary provides good safety briefs.
- Condition of recreational craft is very good in Clear Lake (although not so good in or towards Bolivar).
- The state minimal requirements for operation.
- Violations are usually fire extinguishers and other relatively minor violations.
- Intoxication enforcement is stringent.
- Security zones physically separate where small craft can operate.

Volume of Commercial Traffic

Today:

- ***This is the second largest chemical tanker port in the world. A tanker may come in for two weeks and visit up to seven docks.***
- Traffic is concentrated in the middle with ferries at Lynchburg to Green Bayou to San Jacinto River north and west up to the I-610 Beltway Bridge (i.e., Sam Houston Bridge).
- There are barge facilities further up inside ship berths in high traffic areas.
- Cargo consolidation issue: deep draft petrochemical carriers must make tough and expensive choices in shifting berths to consulate cargos. This at times requires orchestrating with numerous other vessels and berths resulting in numerous transits within the port or to anchorage.
- Ships are being moved around because of the lack of available berths.
- There are not enough fleeting areas. Barges are being held in the mud banks in bad spots.
- ***About 2,000 barges are within the Houston Ship Channel transportation system at one given time.***
- There is constant traffic through the hole outside the VTS area especially in the fleeting areas on the San Jacinto River and Old River.
- There is a large volume of traffic at the intersection of the Houston Ship Channel and the ICW and at the intersection of the Texas Y and ICW.
- Incidents are happening further out than before. There is a lot of changing of radio frequencies near the Galveston approaches and the Galveston jetties. Pilot boat crews have taken up functions similar to the VTS in this area. Gulf Bravo was shifted seaward roughly on a 135 heading. We've had some close calls near where Gulf Bravo is and used to be.
- Vessel traffic is compounding problems with communications.
- Coordination between faster ships (cruise) and slower freighters is not always optimal.
- VTS operators and dispatchers are in nearly constant communication. In the area beyond buoy Gulf Bravo there is a concern due to lack of authority.
- Commercial needs tend to reduce movements based on efficiency.
- Ports that have someone overseeing efficiency of commercial movements seem to be more efficient.
- The Port of Houston is too big for a Harbor Master.
- There are 55 sea miles from the pilot station to the turning basin, which is a long and winding way, prone to things getting stopped up when there's a problem.
- Commercial traffic volume is large and will get larger due to the 45-foot project at Texas City and Galveston.
- Ships are most efficient when they come in with a full load, discharge cargo, reload, and leave, but when a ship comes in with palm oil and leaves with benzene, for example, it needs to be cleaned and such, which impacts traffic density and volume with four to five additional transits. New requirements often cause more transits. More cargo that must be "vapor destroyed" in port requires more transits. Ongoing environmental initiatives could seriously impact movement up and down the ship channel or tie up docks.
- There is a network of working groups that is looking at ways to figure out the best utilization of resources, such as using 15-minute increments instead of 2-hour increments, but the port cannot keep up with (or catch up to) demand indefinitely by implementation of clever ideas.
- In terms of infrastructure capabilities, maintenance of the channel is becoming more expensive and government assistance is around 30%.
- Army Corps of Engineers and recent soundings indicates 50% width of channel is at project depth 90% of the time.

Trends:

- New berths are being drafted or sheet pile is being added to high volume areas.
- Fleeting areas are moving ever closer to the edges of the channel.

Existing Mitigations:

- VTS reduces risk.
- Port partnerships reduce risk.
- AIS reduces risk.
- The Pilot's Association tries to line up vessels in terms of speed and destination.
- The volume of commercial traffic is made less risky by a healthy respect between brown and blue water in this port, relative to many other ports.
- Port has among the highest standards of technical software tools and a high level of expertise in those tools.
- Dispatching coordinates closely with tugs and similar vessels.
- Although traffic volume is high, it is handled well.
- Coordination includes effective measures such as shutting down movement of certain vessels when necessary.
- All Houston pilots have a personal precision navigation system which helps tremendously.
- Deepening and widening in barge lanes helps a little, though mostly it does not help since as anticipated larger ships came in after deepening and widening.
- General risk mitigation strategies are Volume of Small Craft Traffic:

Volume of Small Craft Traffic**Today:**

- Small craft are recreational boats.
- Recreational boating is year-long, not seasonal.
- There are approximately 7,000 boats on Clear Lake.
- Many boats on Clear Lake rarely/never leave their berths.
- Beyond Clear Lake area, ICW and Texas Y has some small craft traffic.
- Used to be a launch out of a boat ramp in the Texas Y area, but not since Hurricane Ike.
- Outside Houston Ship Channel and ICW, recreational fishing boats like to hover.
- Fishing for redfish could affect the Houston Ship Channel depending on where the redfish are.
- Galveston Railway Bridge has the highest small craft traffic volume. (The bridge is being replaced and the area widened in a couple of years.)

Trends:

- [None specified]

Existing Mitigations:

- Barge lanes reduce risk.
- Aids to navigation help keep traffic separate and on course.
- Forewarnings from the VTS reduces risk.

Traffic Mix**Today:**

- Entire area has a diverse mix, but the Galveston Channel has the most diverse mix, including shrimp boats, sailboats, recreational boats, cruise ships, deep draft, oil rigs, and barges.

- Turning into Galveston itself has a diverse mix and it is a sharp turn, maybe 90 degrees. (Not everyone is aware that turning slows a ship remarkably.)
- Recreational boaters from Clear Lake and Bayport effect the Bayport Shipping Channel. This area is out of scope for this workshop, but has potential growth for impacting safety due to ongoing and proposed developments.
- A rig repair facility in Galveston causes occasional movement through the approaches and the Texas Y.
- There is a diverse mix in the Galveston Channel entrance and no one follows a traffic scheme.

Trends:

- Nation’s largest petrochemical complex is here. As additional container berths come online, we’ll see more traffic in the one-way channel.

Existing Mitigations:

- VTS reduces risk.
- Barge lanes reduces risk.
- Aids to navigation reduce risk.
- There is good group coordination between stakeholders.
- There are various committees that bring brown water and blue water together regularly.

Congestion

Today:

- The current state of Congestion is mostly the same as for Traffic Mix.
- Much data has been taken, but analysis does not indicate clear peak days or times of congestion.
- Wide body tankers have daylight restriction, so they have priority in the mornings.
- Other than wide body tankers, congestion is constant.

Trends:

- [not specified]

Existing Mitigations:

- Existing mitigations for Congestion is mostly the same as for Traffic Mix.

Winds

Today:

- Houston winds are mostly less than 20 knots.
- Winds are less of a safety issue than a congestion issue.
- Sometimes there are 20 knot winds directly out of Galveston, which is a risk factor.
- Groundings in 2008 were attributable to northerly winds.
- Winds less than 20 knots from the wrong direction can be difficult.
- Towing industry and deep draft vessels are affected by winds.
- *Fleeting areas can fill up with barges quickly due to unfavorable winds from the north causing a drop in the channel depth.*
- Bolivar has some crosswinds, but wind blowing tide is worse than the wind itself.
- Bayport is proving its expectations in terms of container ships, crosswinds, and a narrow channel leading from the flair.
- NOAA doesn’t have real-time wind information for Bolivar.

- If wind has a strong NW component, it creates a challenge, requiring resources to be shifted.
- High winds cause loading up of the fleet area.

Trends:

- [None specified]

Existing Mitigations:

- Fleets provide a place to go when wind is too strong.
- Wind is rarely surprising due to NOAA’s National Weather Service forecasting.
- There is active tracking technology and Internet access to wind information.

Water Movement

Today:

- *Not as robust and survivable as they could be, but when up and working, the Physical Oceanographic Real-Time System (PORTS) buoys are highly advantageous.*
- Rain heavily impacts currents and flush out.
- San Jacinto has a huge watershed affecting currents in the San Jacinto and Houston Ship Channel.
- ICW has crosscurrents from Bolivar to Pelican Bay, especially barge traffic turning inbound.
- In the Texas Y, there can be currents up to 2 knots and sometimes 3 knots, which has a large effect on long tows.
- Unpredictable current across the bar can be problematic also, out from the end of the jetties.

Trends:

- [None specified]

Existing Mitigations:

- PORTS is invaluable.
- Broadcast notices to mariners reduce risk.
- Float tests were performed to determine speed of the water in various locations.
- “Good port coordination-style high water team thing.” (Correlated to “habitual trust and competence”.)
- There are extremely accurate state predictions of upland flooding.
- Current meters which deliver info via the Internet are installed at San Jacinto Bridge and the Galveston causeway.

Visibility Restriction

Today:

- Due to Ike, the recent season has been easy in terms of fog, but before that primarily seasonal fog was heavy (Spring and Fall).
- Fog can kind of be seen coming ahead of time, but the weather service is reluctant to predict fog.
- There is more radiation fog on upper channel, but the advection fog that sets in from Morgan’s Point or Redfish on down is hard to predict and even harder to predict when it’s going to lift.
- A rain squall causes very low visibility.
- Whereas fog can be chronic and difficult, rain can be acute and more difficult while it lasts.
- Visibility isn’t significantly better or worse at different points on the channel.

Trends:

- [None specified]

Existing Mitigations:

- *VTS identifies / communicates water conditions important to the maritime community.*
- *Communication on the waterway is good.*
- There is a good relationship with VTS to use video feed to help with visibility restrictions.

Obstructions

Today:

- There are industry induced obstructions such as dredging and major cranes working large pieces of cargo.
- From a tow boat perspective, mast headlights cannot be seen.
- In the middle, there are blind spots compounding light pollution.
- There are many submerged craft with no markers or GPS coordinates available. This hasn't apparently caused a lot of problems so far.
- This is the fourth largest metro area of the country, which also has a port running through it and several chemical plants.
- Above Morgan's Point there is limited fleet space and limited options for more fleet space.

Trends:

- [None specified]

Existing Mitigations:

- There is good communication about obstructions, such as dead ships.
- There is a good framework for decision-making, not a restrictive written plan.
- The VTS website has good tools related to obstructions, such as categorization of obstructions and requests / procedures.

Visibility Impediments

Today:

- Light intensity and color has been changed in some locations, but problems persist.
- The Baytown range is difficult.
- The entire system of the port as a whole has improved.
- The range coming into Bayport with big ships is getting tough now due to further development.
- *This is the most challenging port in North America in terms of light pollution, making it difficult to see navigational aids.*
- There are industry-induced obstructions such as dredging and major cranes working large pieces of cargo.
- From a tow boat perspective, mast headlights cannot be seen.
- In the middle, there are blind spots compounding light pollution.

Trends:

- With business levels down, stacked barges are everywhere, making things worse by encroaching on the main channel.

Existing Mitigations:

- Mariner experience reduces risk.
- Highly qualified pilots reduce risk.
- The only significant technical improvement on the channel in many years is the high-intensity super range lighting that is visible in the daytime.
- Newer types of indirect lighting, such as in Bayport, help tremendously.
- ECDIS reduces risk.
- Blinding light can often be solved with communication between facilities, waterways management, and industry. (Blinding light is most often caused by terminals.)
- Operators are being sensitized to the issue of dredges with strong spotlights aft.

Dimensions**Today:**

- Traffic above Greens Bayou is one-way depending on the dimensions of the deep draft vessel. (This area was out of scope for the workshop.)
- Above Greens Bayou, there are rules restricting the beams of ships traversing the area. LPG ships and gas ships have a few particular restrictions.
- The middle area up past Barbours Cut doesn't benefit from barge lanes the way that the Galveston Bay does.

Trends:

- [None specified]

Existing Mitigations:

- Industry induced waterway movement creates hydrodynamic problems due to the dimensions.
- The port has good dimensions relative to other ports.
- VTS reduces risk.
- AIS reduces risk.
- Industry communication in dispatching ships helps to reduce risk.
- There are specific rules and recommendations related to the dimensions of the channel for certain vessel dimensions and cargo types.
- Traffic mix is altered to mitigate risk due to dimensions.
- HOGANSAC makes recommendations to port community which helps with dimensions issues.

Bottom Type**Today:**

- There is rock along Morgan's Point along the Green side, but generally 4,000 feet of unconsolidated sediment yields soft bottoms.
- There is shoaling in the bar channel and above the Beltway Bridge.
- The deepening and widening project began about four years ago, so it is unknown what the re-dredging requirement will be for maintaining the channel at the 45-foot depth.
- Around Bolivar, the entrance around buoy 20 eastbound is a natural collection point. The first indication starts around buoy 11 or 12.
- There is shoaling in anchorage around buoy 16, which limits the use of the anchorage.
- There is shoaling in the Bravo anchorage.

- Sometimes pilots have a difficult time convincing the captain that there is an additional two feet.

Trends:

- [None specified]

Existing Mitigations:

- Good muddy bottom type.

Configuration

Today:

- Bends, intersections / convergences, and crossing traffic exist at the Texas Y, San Jacinto / Old River area, and the Bayport Flare (out of scope for this workshop).
- There is a high volume of traffic at intersections.

Trends:

- [None specified]

Existing Mitigations:

- Long and curving waterway configuration is accepted and mostly worked around.
- Deepening and widening project took some of the reaches out, yielding fewer turns and longer straight-aways.
- Good communication reduces risk.
- VTS reduces risk.
- A captain can be told to delay moving into ship channel sometimes, but overall the VTS area may not be the right size and shape for the configuration of the channel.

Personnel Injuries

Today:

- There are cruise ships leaving out of Galveston with about two cruises per week, affecting the approaches area.
- A ferry runs between Bolivar and Galveston in the Texas Y.
- The Lynchburg Ferry has potential for personnel injuries.
- There are charter boats and sightseeing boats eight to nine months per year.

Trends:

- [None specified]

Existing Mitigations:

- Deer Park has a hazardous release warning siren and system.
- All cities have an emergency system.
- All affected counties have warning systems.
- Channel Industry Mutual Aid reduces risk.
- There are SPPC plans and risk analysis for products carried.
- Local Emergency Planning Committees (LEPCs).
- One of the LEPCs has started to require all members to participate in monthly Level 3 drills to test their notification system.
- Good hospitals / emergency casualty facilities.

Petroleum Discharge

Today:

- The Texas City Y, San Jacinto, and Galveston approaches all have potential for petroleum discharges.
- Sharp turn into the Carbide Canal and fleeting areas have potential for petroleum discharges.
- Pulling out of anchorages is a risk factor in petroleum discharge more so than approaching the jetties.

Trends:

- [None specified]

Existing Mitigations:

- Double hulls reduce risk.
- Every company and vessel has a plan for spills.
- There are at least four pollution contingency plans on the ships of some participants.
- Significant OSRO presences in the area.
- Clean Channel is a “barge-type, mutual aid outfit.”
- Regulations are in place to prevent spills.
- Though not many locally, there are bilge water treatment facilities where fishing vessels are concentrated.
- There is a significant amount of qualified people who know how to deal with petroleum discharge in the Houston-Galveston area.

Hazardous Materials Release

Today:

- The area handles a tremendous amount of gas products such as butane, propane, LPGs, and ammonia, which could be quite serious.
- ULCCs / VLCCs discharge closer in than the lightering areas.
- Many hazardous material releases would be direr than petroleum release because of various noxious properties of the materials and because many are gasses and can therefore be airborne.

Trends:

- [None specified]

Existing Mitigations:

- The port has the best hazardous materials responders in the country.
- A number of contractors have Level A or B teams with portable gas chromatographs.
- Contractors are required to have air sampling equipment.
- There is fixed location air quality monitoring equipment and mobile air monitoring trailers can be used in certain situations.
- CDC classification of many flammable hazardous materials gives higher attention and scrutiny.
- There are significant consequences to a release, but systems are in place to control the risk.
- Numerous contingency plans are in place for facilities, vessels, and communities.

Mobility

Today:

- Barges may be able to get through if an obstruction happens below Morgan's Point, but generally a grounding will halt mobility.
- A major sinking or grounding within the Houston Ship Channel will disrupt the nation's petro-chemical distribution system.
- If the Bolivar Ferry is knocked out, there is a large human mobility issue.
- The Bolivar Ferry is an unofficial but critical evacuation route for the Bolivar peninsula in case of disaster.
- I-10 and I-610 would cause larger mobility problems than the Bolivar Ferry if they went out. I-10 is the major traffic artery for east and west coast travel.
- There is no redundant VTS communications capability in cases of disaster.

Trends:

- [not specified]

Existing Mitigations:

- Knowing who knows where the pipelines are can increase mobility of products.
- Looking at alternate means of moving product with different vehicles, such as nationally known and well-respected groups like the HOGANSAC subcommittee.
- Extra safety stocks are built up if fog season is impending.
- The Houston Pilots Association has a hardened facility about 200 miles inland with capability to completely shut down presence in Houston and operate the port from this remote location to restore mobility after a disaster like Hurricane Ike.
- Facility validation allows the quick availability of mobility of products when power is restored.
- Close coordination with tugs.
- Good communication with pilots through dispatchers.
- With potential large impacts to commerce comes the need for pre-staged equipment to handle mobility impediments.

Health and Safety

Today:

- There are significant populations near the waterway for each zone indentified in this workshop.
- There is housing north of I-10 and east of Deer Park.
- The Texas City Y area has a dense population.
- The only area without heavy population is on the East side of the Galveston Bay.
- 2,500 or 3,000 barrels may be released as a most probable discharge.
- The Texas City Y and the Texas City turning basin are important areas in terms of safety and oil spills.

Trends:

- [None specified]

Existing Mitigations:

- Existing mitigations for Health and Safety is similar to those for Personnel Injuries.
- Air monitoring is in place.
- Sirens alert the populace to warn of impending danger.
- Plume modeling reduces risk.
- There are mass evacuation plans, contingency plans, and shelter-in-place plans in place.

- News networks generally reduce risk through facilitating communication to the populace.
- There is good healthcare and a good emergency response structure in the area including LEPC, Coast Guard, fire department, and local police.

Environmental

Today:

- Galveston Bay is an environmentally sensitive area.
- A huge wetland program is going on near Pelican Bay and Brownwood.
- The Texas City dike area and each of the beaches are sea turtle egg-laying areas.
- Bolivar Marsh is a rookery.
- Pelican Island is environmentally sensitive.

Trends:

- Things are getting more environmentally sensitive versus ten years ago.
- Increasingly difficult to get an open water dredging permit.

Existing Mitigations:

- There are local and Federal environmental response and protection systems.
- Large numbers of people are ready to respond.
- Work closely with the Texas General Land Office (TGLO), Coast Guard, and TCEQ which focus on primary areas to be protected.
- Regular tabletop drills are conducted in many industries / companies.
- The marsh and Bird Island preserve a large amount of wildlife.
- A good relationship exists with Galveston Bay Foundation for addressing environmental concerns.
- Detailed and digital area contingency plans were developed, including the use of rangefinders calculated distances between every cut in the bay, thanks in large part to TGLO.
- Natural resource damage assessment is implemented by the state and coordinated with the stakeholders involved to properly restore those resources.
- Navigational processes within the channel are well-coordinated with the Coast Guard in sensitive areas.

Aquatic Resources

Today:

- There are multiple major fisheries below Barber's Cut.
- Shrimp and oyster are the major fishing species. Shrimpers run in the bay and out into the Gulf of Mexico.
- Other significant species exist. Fishing is year-round.
- Oysters are diversely located but the most sensitive to spills, partially due to the fact that they cannot relocate to avoid pollution.

Trends:

- [None specified]

Existing Mitigations:

- Aquatic Resources are largely the same as Environmental Consequences.

Economic

Today:

- Impacts have been estimated to fall into the vicinity of approximately is \$13.3 million per hour if the Houston Ship Channel is shut down.
- Impacts could be \$330 to \$400 million per day, which is a significant impact to the nation's economy.
- Refineries run out of feedstock after a week or two after which continuity of operations is majorly disrupted and economic effects are felt past the local level.

Trends:

- [None specified]

Existing Mitigations:

- For the brown water fleet, a network of response boats resources has been created to open up inland waterway more quickly than through the regulators.
- The area has numerous cooperative agreements for the sharing of recovery equipment.
- There is a hurricane preparedness plan including a memorandum of understanding with VTS for specific channel opening processes.
- For shallow draft vessels, it is workable for short duration interruptions such as fog and general hurricane recovery, but for sustained closures, it takes a long time to clear the channel for midsized and larger vessels.
- The Commercial Recovery Contingency Group reduces economic risk.
- The Maritime Security Committee (MSC) has a commercial recovery plan.
- Other groups have commercial recovery plans but specifics are not widely known / communicated.

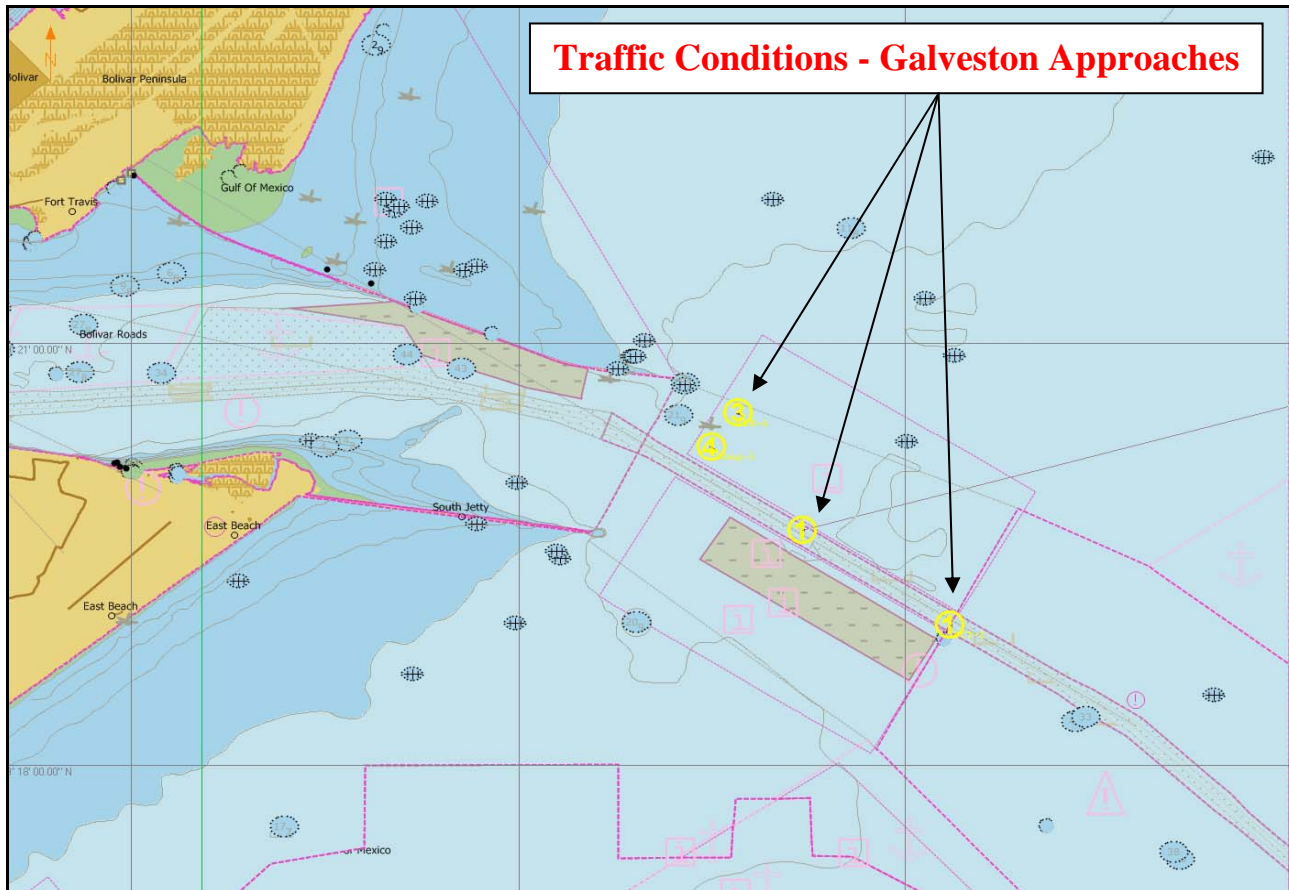
Appendix C

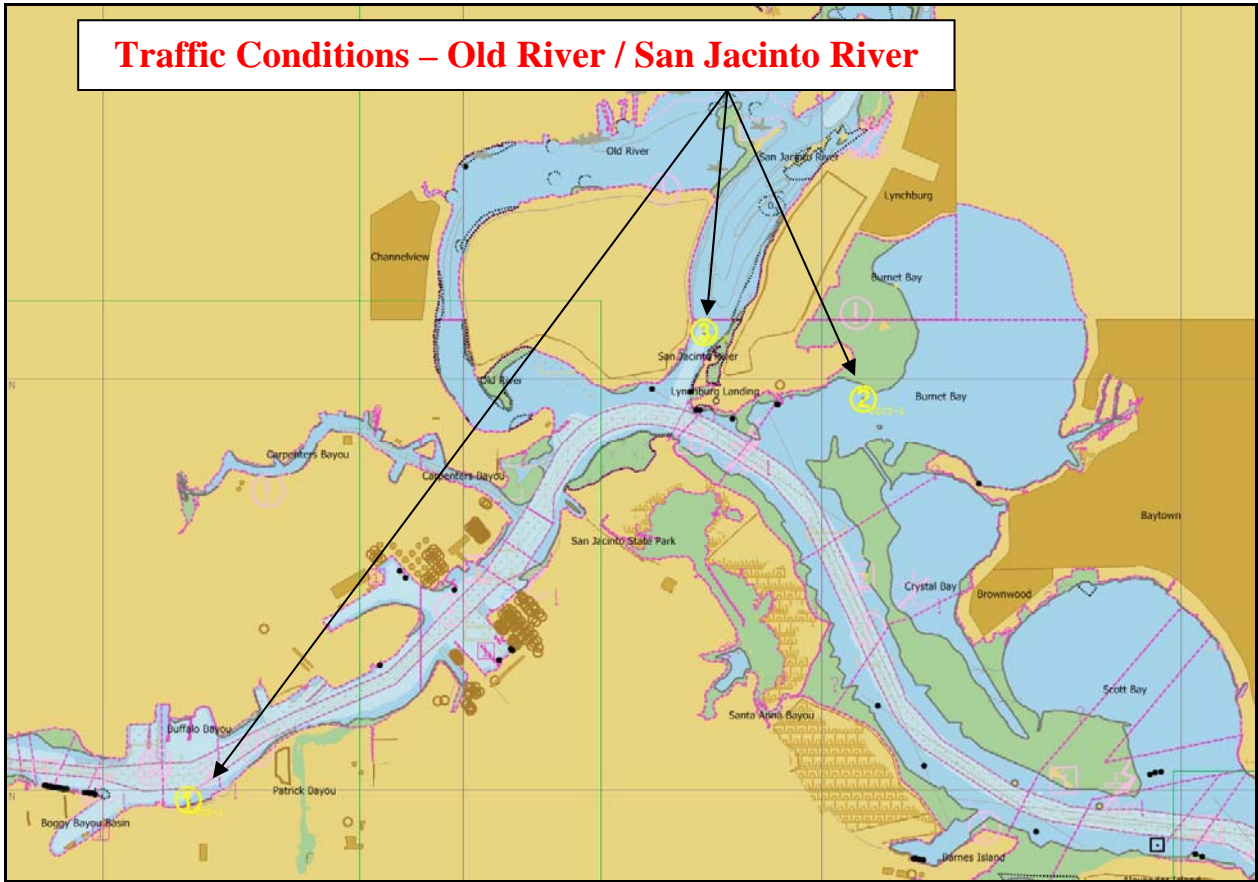
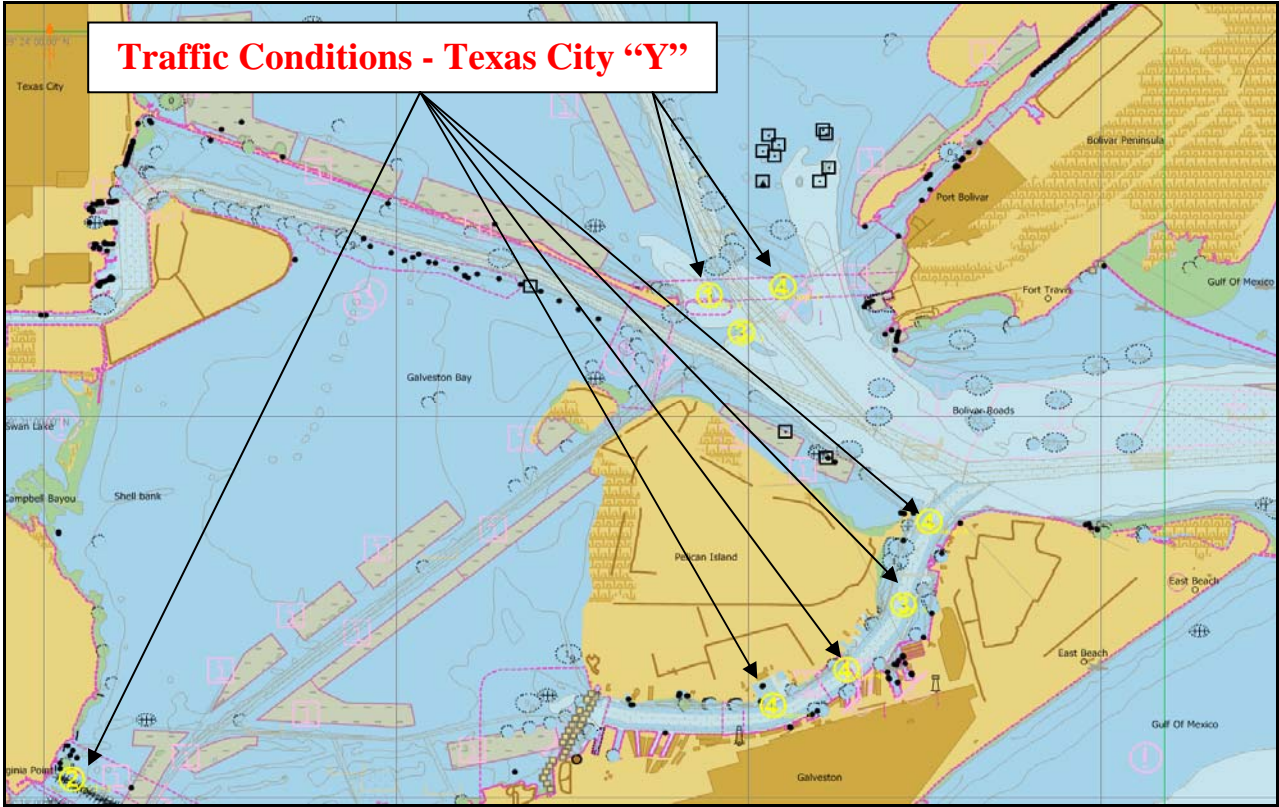
Waterways Risk Model – Risk Factor locations

As participants discussed the Waterways Risk Model factors, an Electronic Charting System (ECS) was utilized to identify the specific geographic locations associated with the risk factors.

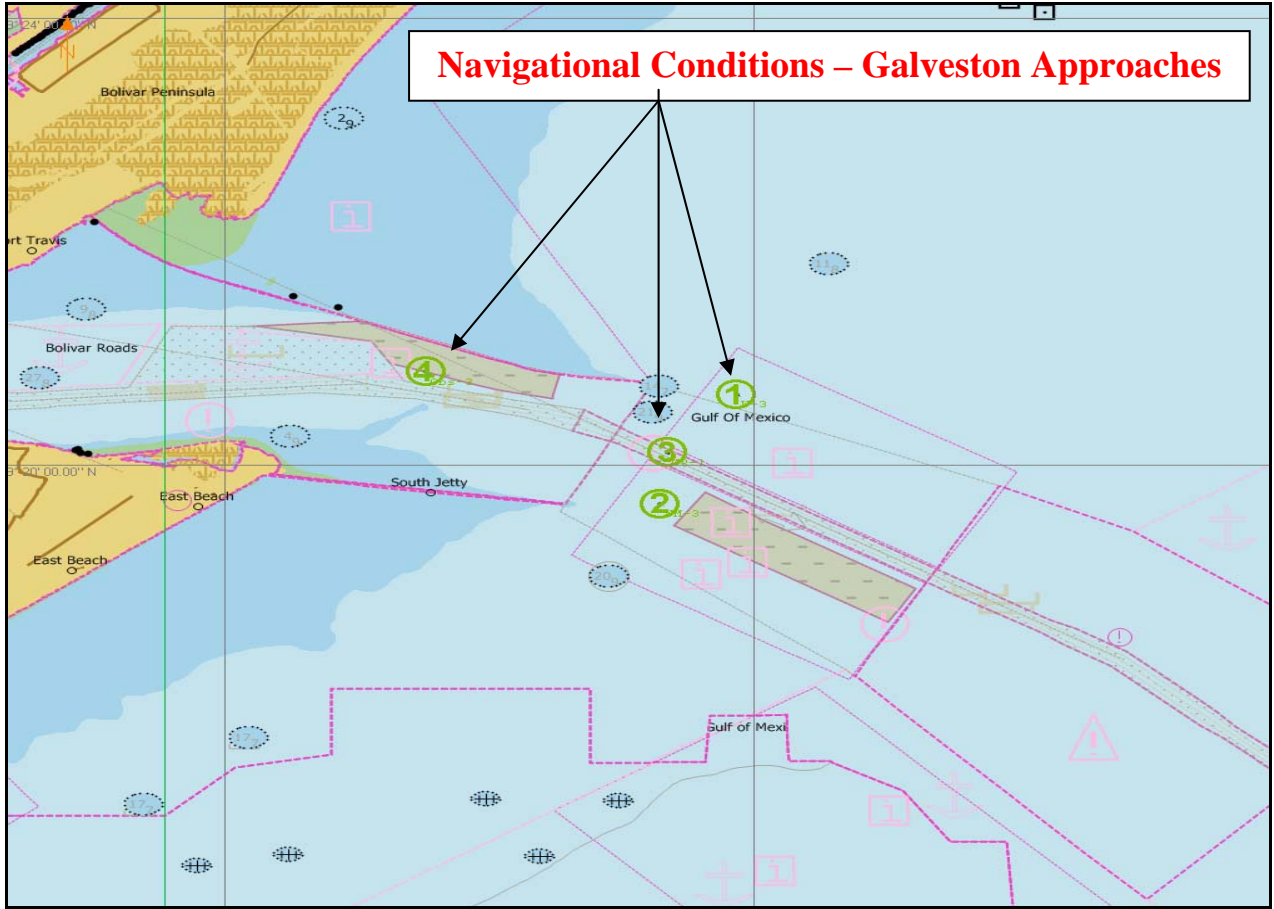
The following legend explains the risk factor locations on the ECS chart excerpts.

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

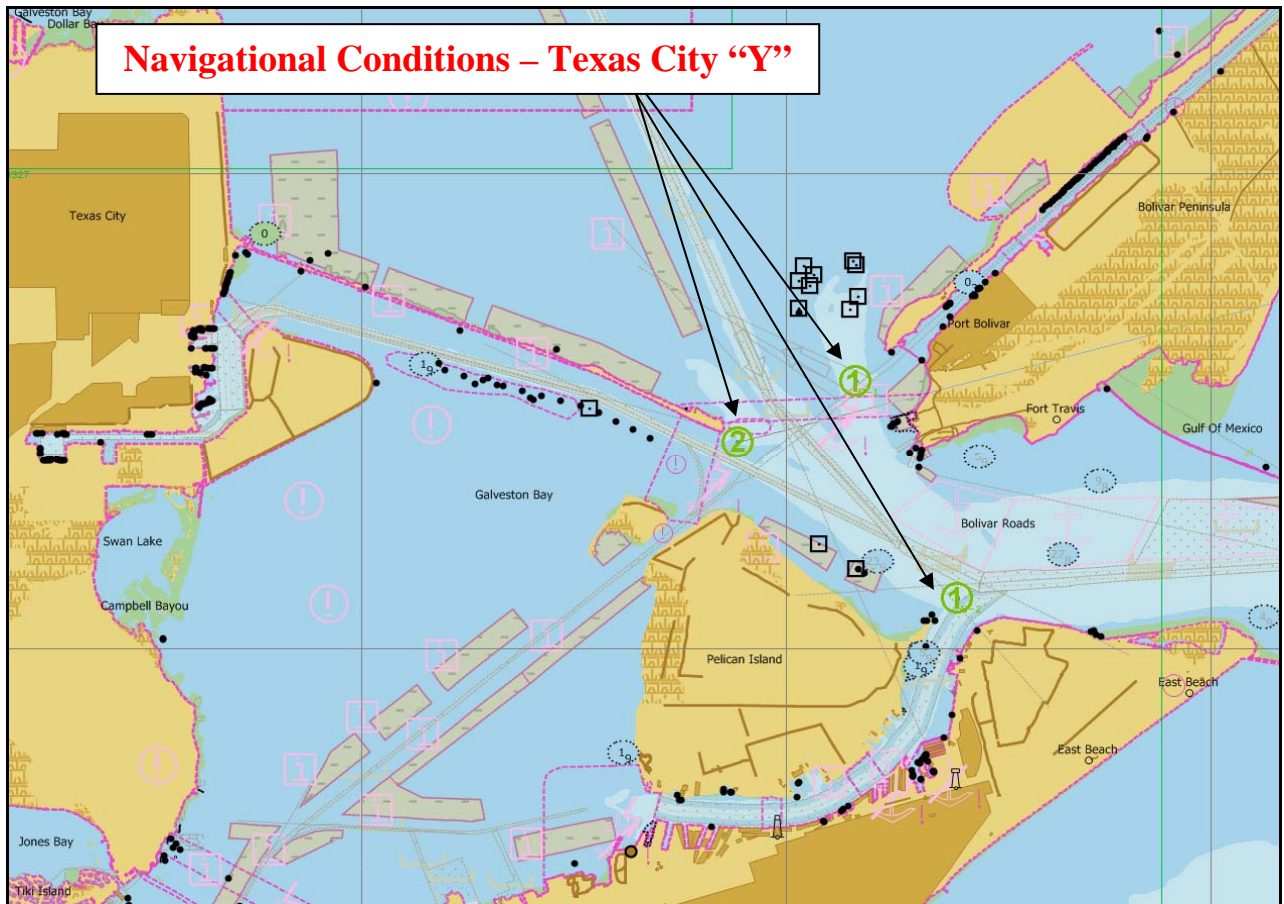




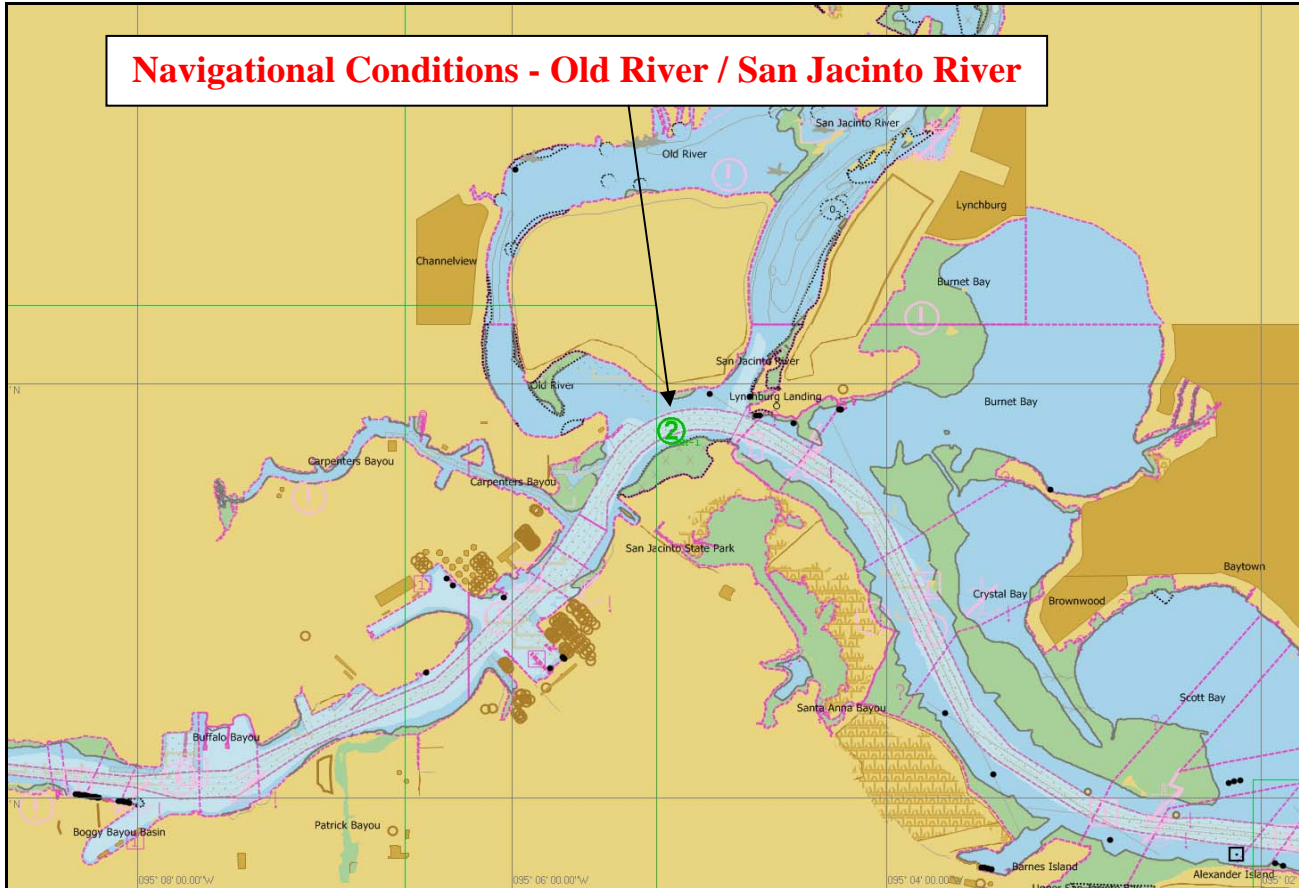
Navigational Conditions – Galveston Approaches



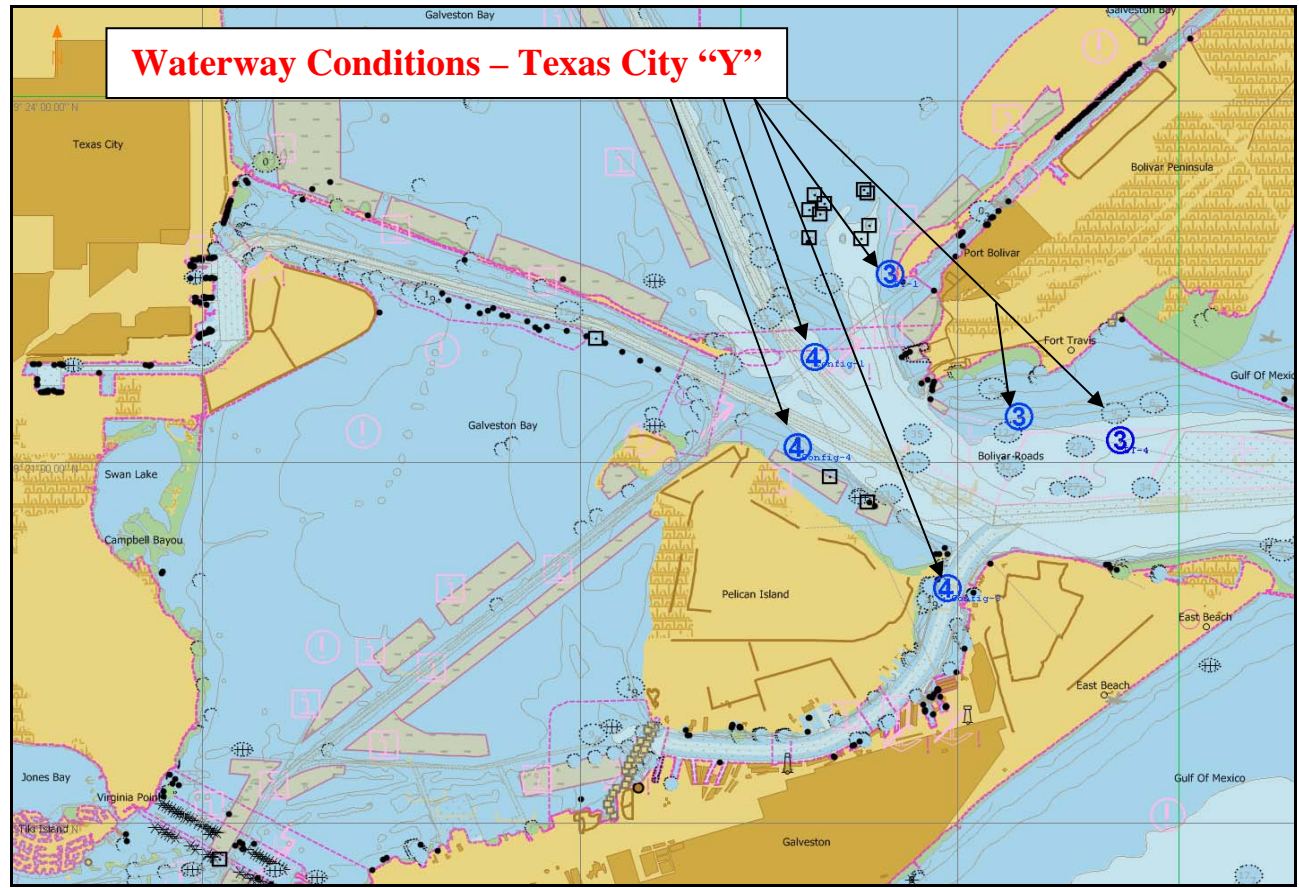
Navigational Conditions – Texas City “Y”



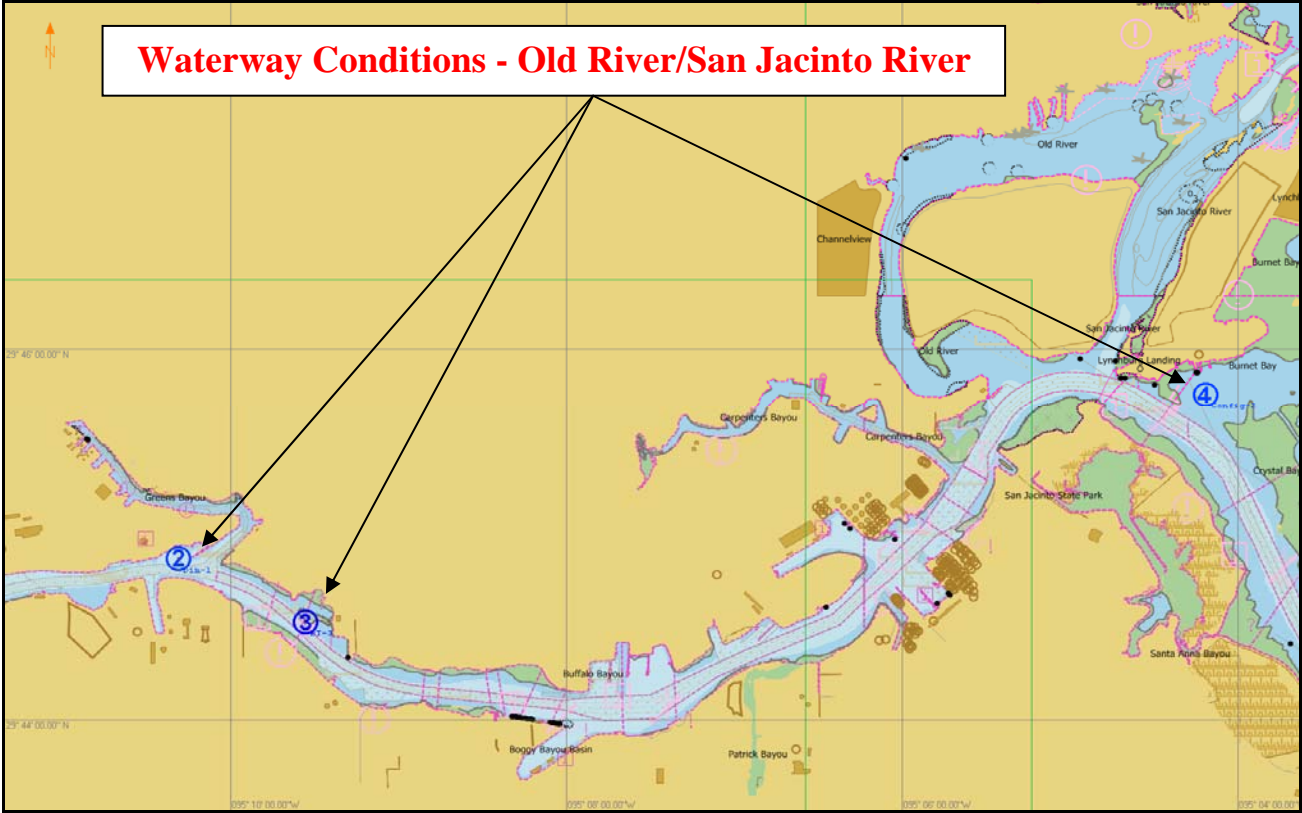
Navigational Conditions - Old River / San Jacinto River



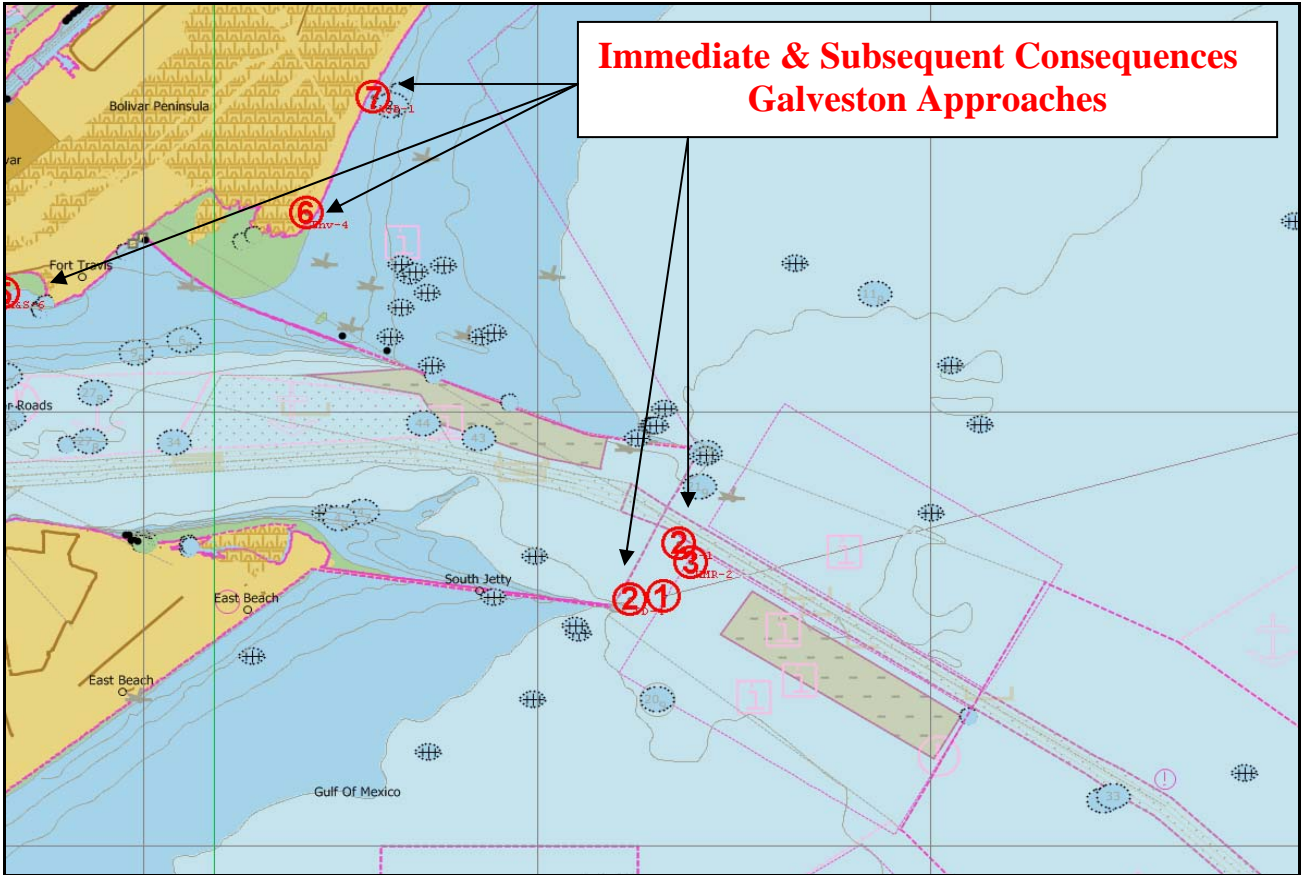
Waterway Conditions – Texas City “Y”



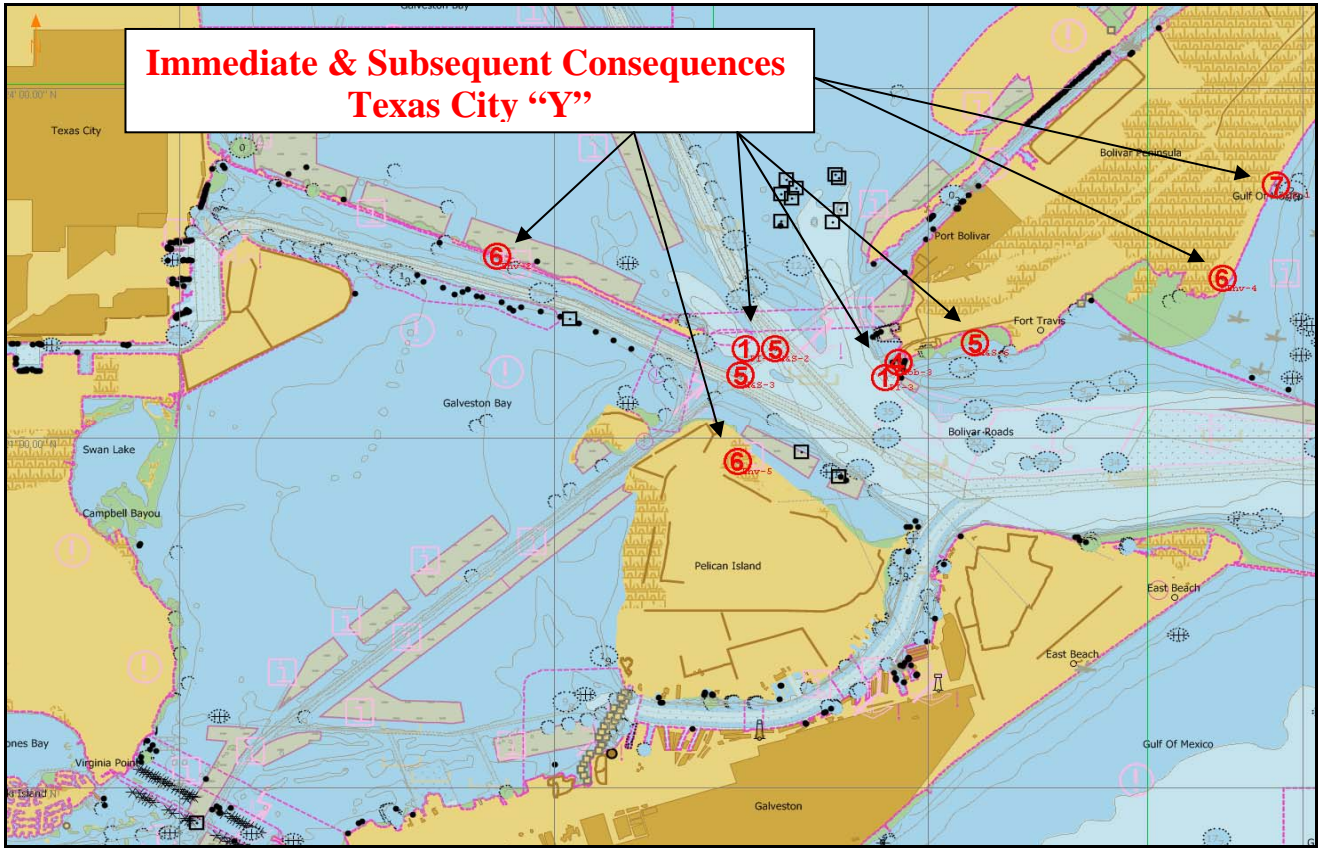
Waterway Conditions - Old River/San Jacinto River



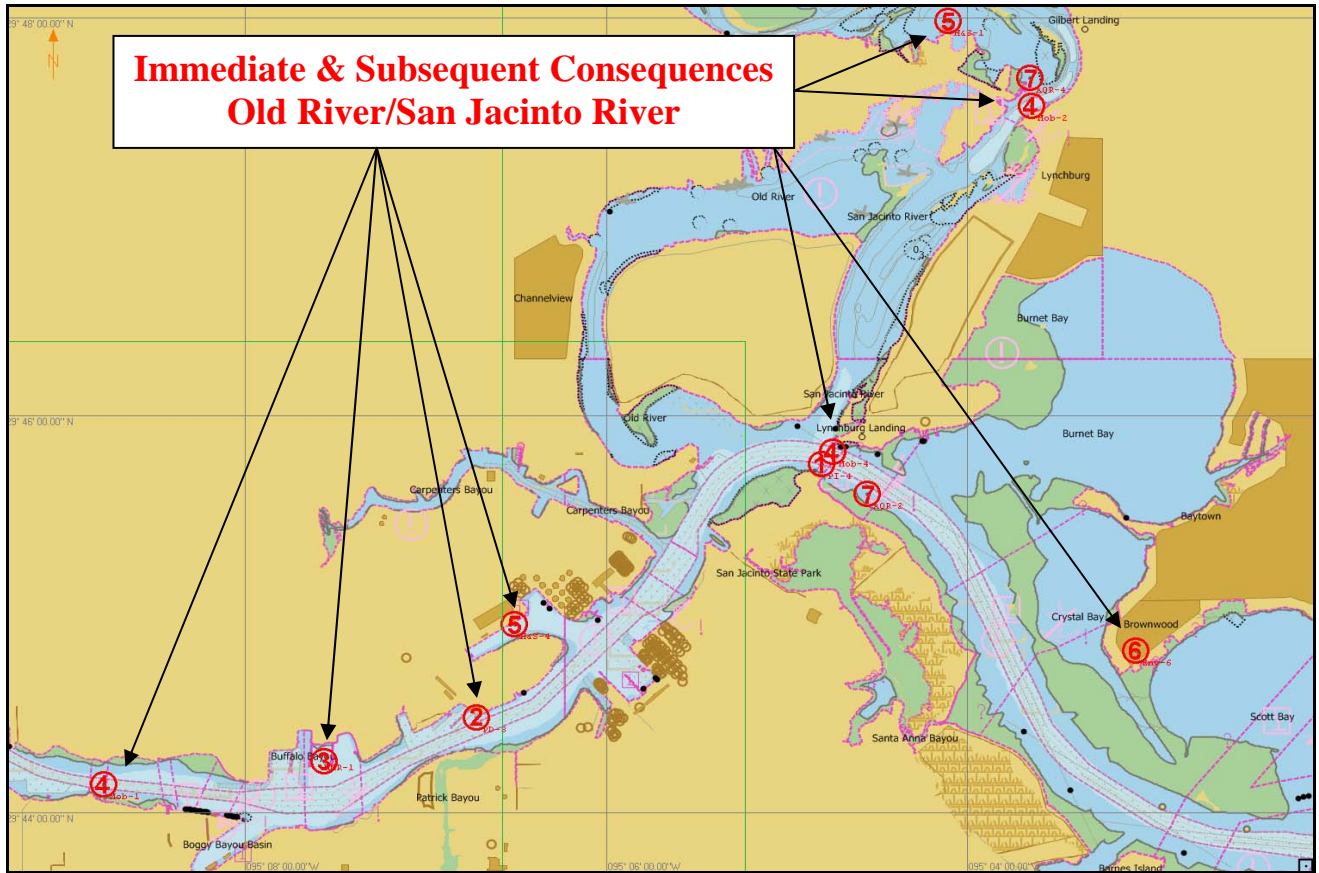
Immediate & Subsequent Consequences Galveston Approaches

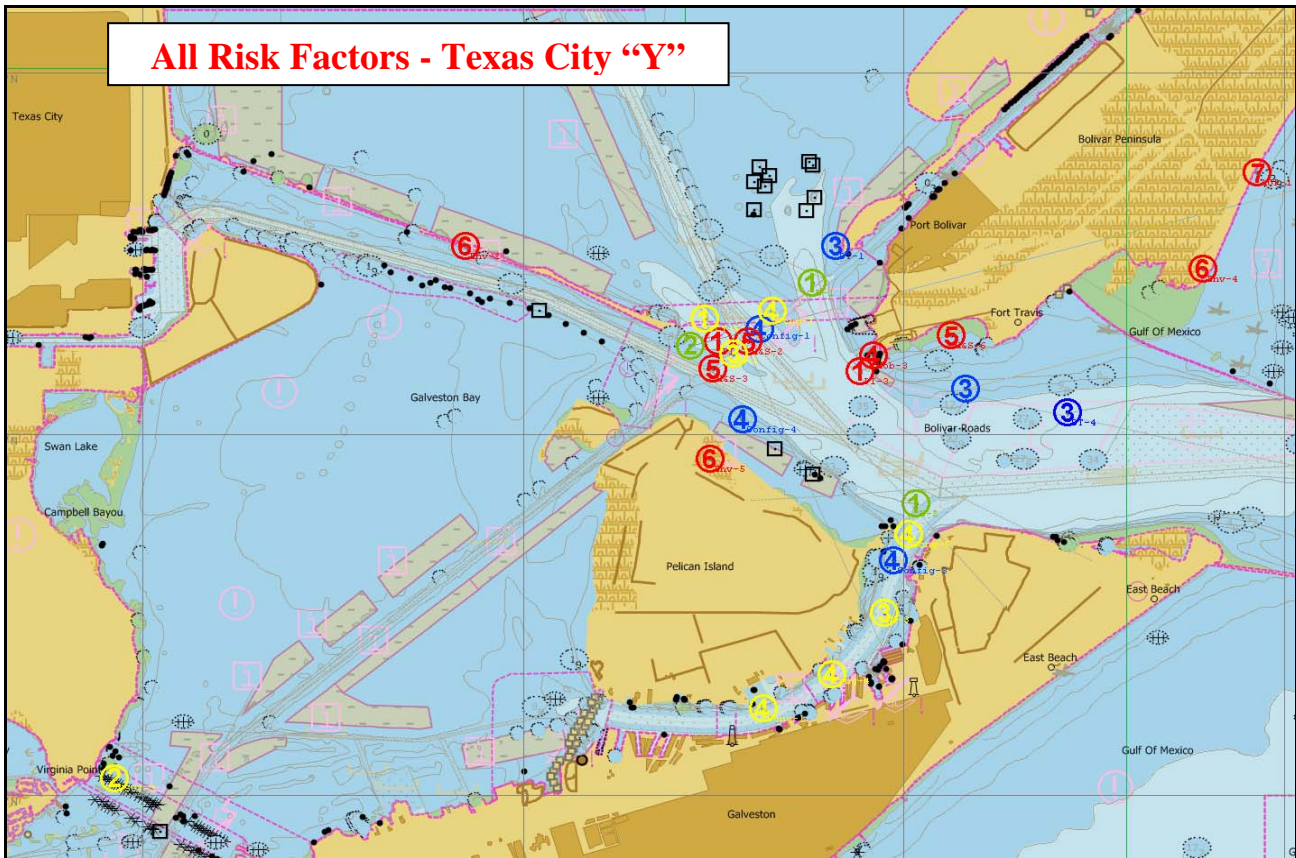
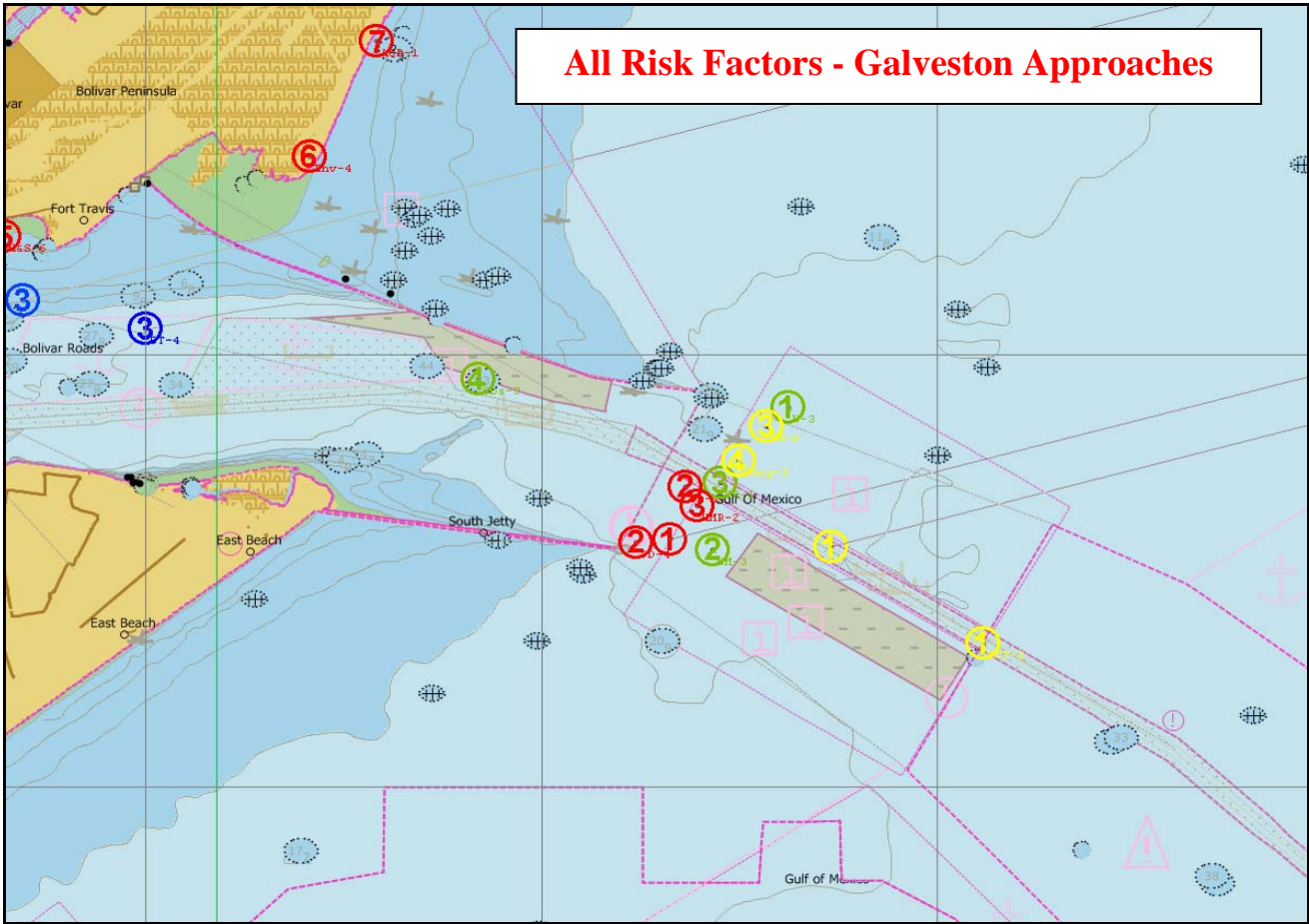


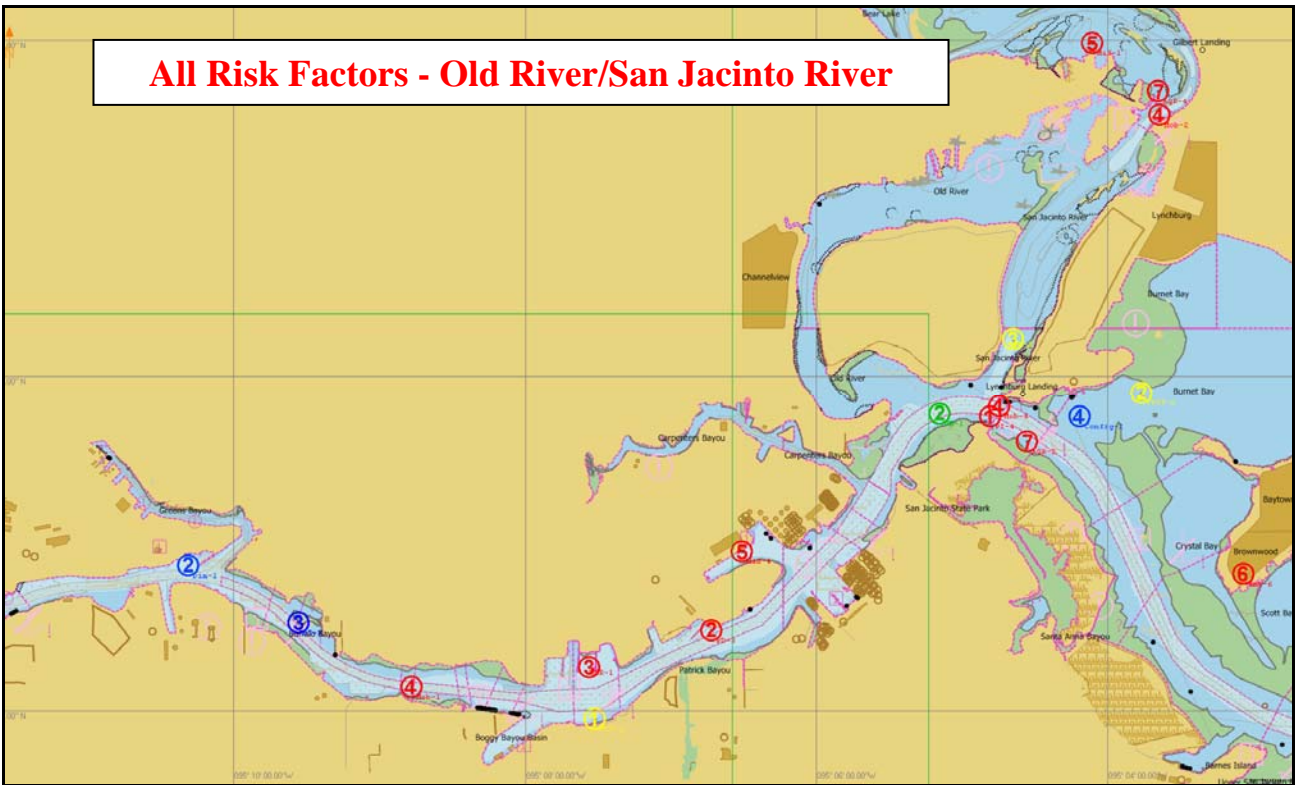
**Immediate & Subsequent Consequences
Texas City "Y"**



**Immediate & Subsequent Consequences
Old River/San Jacinto River**







Appendix D

Risk Mitigation Strategy Descriptions

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

Appendix E

Additional Risk Intervention Strategies

Shallow Draft Vessel Quality

Coordination/Planning

- Education and awareness for non-rigid composite units (wire boats) or establish policies and procedures for these types of tow boats. (5) Voluntary Training
- Encourage voluntary compliance of the proposed towing vessel regulations. (5)
- Brown water video-based simulators significantly increase mariner proficiency in terms of situational awareness. (1)
- Second generation simulators can increase actual proficiencies such as boat handling. (1)

Rules & Procedures

- Encourage the implementation of the proposed Towing Vessel Regulations. (3)
- Possible regulation of the Bravo anchorage could reduce risk to ferries and anchored shallow draft vessels. (1)
- Encourage facilities to modify bunkering policies to help with / relieve vessel congestion. (1)

Radio Communications

- Possibly ECDIS and electronic charting should be required for operating in restricted visibility situations. The better operators have put Electronic Chart Display and Information System (ECDIS) on their boats already. The one vessel in restricted visibility without this capability can impact the whole port. (5)
- Encourage facilities to modify bunkering policies to help with / relieve vessel congestion. (1)

Waterway Changes

- Maintaining anchorage to proper depth throughout the marked anchorage would encourage more anchoring in the southern ends of the anchorage which may reduce risk to ferry routes. (5)

Commercial Fishing Vessel Quality

Voluntary Training

- Assist in creating education programs for the fishing fleet so they fully understand the rules of the waterway and safety. (5)

Enforcement

- Enforcement is needed in precautionary areas offshore. (7)

Radio Communications

- AIS requirements for fishing vessels. (1)
- Get fishing vessels to actively monitor their radio and respond to hailing vessels. (1)

Other Actions

- Work through the Houston Galveston Navigations Safety Advisory Council (HOGANSAC) subcommittee for actions on fishing boats off-shore, in the Texas Y, and in the approaches. (4)

Traffic Mix

Coordination/Planning

- A single “common passage plan” developed by port stakeholders that addresses all issues. (6)

Voluntary Training

- Awareness training for brown water industry for strategies for how tow boats can avoid the suction of deep draft vessels and other vessel interactions. (7)

Navigation/Hydrographic Info

- Barge lanes marked clearly on charts would help separate the traffic mix. HOGANSAC and the Coast Pilot are good ways to get this out. (6)

Waterway Changes

- Reduce blue and brown water in the mix by new policies on how blue water ships bunker, change crews, etc. to reduce unnecessary ship movements and by increasing bunkers / stores at docks and anchorages. (5)

Other Actions

- Develop the book / pamphlet “Navigating the HSC”. Coordinate with HOGANSAC. (4)

Congestion

Coordination/Planning

- Development of a “Common Passage Plan for the Houston-Galveston Ports and Waterways”. (6)

Voluntary Training

- Awareness training regarding how vessels interact and need to work with each other. (6)

Rules & Procedures

- Expand the VTS Area to include the San Jacinto River and Old River to the I-10 Causeway; the GIWW southwest to Red Can Bend (MM359) and northeast to a couple of miles before the government moorings at MM338; and the Galveston Entrance Channel seaward to the sea buoy or boundary line. Enhance VTS coverage of areas where crossing situations obtain and where dissimilar ship types/dissimilar speeds are most encountered. Split the VTSA into three geographic sectors. (5) Re-designate VTS reporting points to take account of changing traffic patterns, increased traffic congestion, and improved sensor capabilities.⁵

Navigation/Hydrographic Info

- Notice provided / marked on chart about where barge lanes begin and end and other clarification of traffic mix; potentially introduce information in the Coast Pilot. (5)

Radio Communications

- Establish a common VHF channel in the off-shore approaches.
- Establish a third traffic management radio channel for moving ships (in conjunction with splitting the VTSA into three geographic areas). Retain VHF Ch-05A as dedicated Sail Plan submission circuit. (5)

Waterway Changes

- Full service lay berths (including ship’s business such as crew changes, stores, fuel, and maintenance). (4)
- More barge fleeting areas for shallow drafts. (1)

Other Actions

- Update and expand the pamphlet (and online availability awareness of) “Navigating the Houston Ship Channel” in cooperation with HOGANSAC. (3)
- Stakeholders with varied interests come together to discuss fair solutions for all users, versus a draconian single point of control. (LPG carriers, crude oil carriers, and car carriers, for example, have different times of day when they need to operate.) A limit to this mitigation is that for chemical tankers this may be chaotic relative to other ports such as Rotterdam.

⁵ PAWSA discussions were focused on a southwest VTSA boundary at Red Can Bend. If changes are implemented, this boundary may be better placed further west, as tows are decisively committed to carry-on eastward when they arrive at Red Can Bend.

Winds

Other Actions

- It would be good around Bolivar and around the ICW past Pelican Island if NOAA would acquire real-time wind information.

Visibility Impediments

Coordination/Planning

- Security on facilities requires more light whereas safety on waterways requires less light. Communication needed with top five light polluters from each segment's perspective including engaging them through HOGANSAC. (6)

Voluntary Training

- Promote the use of AIS. (4)

Waterway Changes

- Change navigational lighting to high intensity "super range" lights versus energy efficient solar-powered lights. (7)
- Lights on day boards enough to navigate from one to the next. (1)

Configuration

Coordination/Planning

- Need the Bolivar Roads Alternate Inbound Route (BRAIR) to be an authorized channel so the Army Corps of Engineers can do regular dredging for shoals. (7)

Voluntary Training

- Improve operator comfortable threshold and use of the BRAIR. (4)

Rules & Procedures

- Expand the VTS Area to include the San Jacinto River and Old River; the ICW to Red Can Bend MM359 on the west and to a couple of miles before government moorings MM338 on the east; and seaward to the seabuoy or to the boundary line. Expand VTSA coverage of areas where vessels enter and depart the waterway and where dissimilar types/dissimilar speeds obtain. Split VTSA into three geographic sectors. (7)
- BRAIR should be mandatory. (1)

Navigation/Hydrographic Info

- Notice provided / marked on chart about where barge lanes begin and end and other clarification of traffic mix; potentially introduce information in the Coast Pilot. (7)

Radio Communications

- If there were three geographic sectors, there may be a need to establish corresponding VHS radio frequencies / channels – improve communication regarding potential configurations of vessels entering the channels. (4)

Active Traffic Management

- Expand the VTS area to include existing fleeting area near the Galveston Railway Bridge, San Jacinto River and the Offshore Galveston Approach, ICW, mile marker number 338, "Red Can" bend. Mitigate all crossings in the 'Y' and elsewhere. (8)

Waterway Changes

- Reduce the waterway congestion and limit unnecessary transit of all categories of blue or brown water vessels – by increasing bunkers and stores at docks. Full service lay berth (to change crew, maintenance, change stock, dockside / wharf access). (5)

Other Actions

- Further develop the pamphlet and improve awareness of availability of the pamphlet “Navigating the Houston Ship Channel” in cooperation with HOGANSAC. (3)

Mobility

Coordination/Planning

- Plan to address a completely blocked channel – “Cooperative Business Continuity Plan”; workflow and responsibilities required for contingencies such as the Army Corps dredging a new channel. (Immediate term – local based) (6)

Voluntary Training

- HOGANSAC “Commercial Recovery Contingency Plan” requires other inter-modal organizations involved and participating in the plan (long term). (2)

Economics

Coordination/Planning

- Allow the flexibility for private industry to resolve the reduced functionality required for their purposes and economic survival. (7)

Other Actions

- Develop national mitigating action plans in order to get the ports and waterways active within certain number of days ... what is the best expectation. National Plan for Economic Recovery. (6)

Note: Workshop participants felt that it was not possible to fully mitigate (eliminate) the risk of a catastrophic shutdown of the channel. The probability is low of a catastrophic failure, but the magnitude of the economic impact is immense, so it may be impossible to call the mitigated the economic risk as “balanced.”