Ports and Waterways Safety Assessment

Workshop Report

St Louis, Missouri

27 - 28 July, 2011

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 that will make 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 PAWSA process and the Waterways Risk Model. 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 conducting a structured workshop to meet these objectives. The process 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.

St Louis PAWSA Workshop

A PAWSA workshop for the Port of St Louis was held in St Louis, Missouri on 27 - 28 July, 2011. The workshop was attended by 16 participants, assembled into 8 two-person teams, representing waterway users, regulatory authorities and stakeholders with an interest in the safe and efficient use of St Louis harbor from both a commercial and recreational perspective. Participants discussed and evaluated 23 of the 24 risk factors that make up the Waterways Risk Model, which includes Vessel Conditions, Traffic Conditions, Navigational and Waterways Conditions, and Immediate and Subsequent Consequences. As an inland -river port, the Deep Draft Vessel Condition risk factor was not discussed or evaluated. For all 23 risk factors evaluated, there was consensus among the participants that risks present in the port were well balanced by existing mitigations. Consensus is defined as 2/3 of the workshop participant teams being in agreement.

A key driver and important aspect of the workshop was to also evaluate the impacts to navigation safety from a proposal to establish three barge fleeting areas along the left descending bank of the Mississippi River in the vicinity of mile marker 180.5. Participants discussed challenges facing larger towing vessel navigating though the various bridges and existing fleeting areas in the downtown St Louis area, and were asked to evaluate the impacts to safety of navigation that could result if the fleeting areas were established. Participants expressed views that the proposed fleeting areas would add to the “gauntlet of fleeting areas” that upbound vessels already have to transit past, leaving them little room to hold-up in the event of an emergency. Participants also expressed views that risks could be reduced by the new fleeting areas because the fleeting area staging vessels would be able to intercept breakaways, from docks and fleeting areas above the Eads Bridge, before they reach the Eads and Popular bridges and the fleeting areas south of these locations.

This report outlines the findings of the workshop, the barge fleeting area evaluation, and a summary of participant comments and observations on trends in the port and existing risk mitigation strategies that serve to “balance” the risks associated with each of the 23 risk factors in the Waterways Risk Model evaluated by the workshop participants. The results of this workshop should be viewed as a starting point to further improve navigation safety and efficiency in the Port of St Louis, Missouri.

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Introduction

The PAWSA process represents a significant part of joint public-private sector planning for mitigating risk in waterways. When applied consistently and uniformly, the process provides a basis for making best value decisions for risk mitigation investments, both on the local and aggregate level.

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

1) Provide input when planning for projects to improve the safety of navigation and support the Marine Transportation System,
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 strengthen 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 waterway and vessel traffic management within their assigned geographic areas of responsibility.

Section 1: How PAWSA workshops are conducted

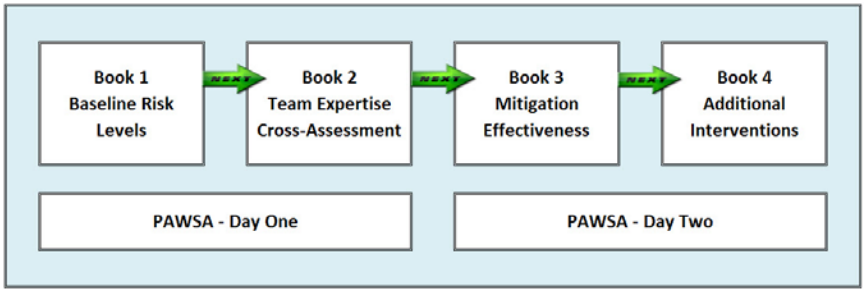
The PAWSA process uses structured workshops for obtaining expert judgments on the level of risk in a port or waterway. The process used a series of discussions and completion of workbooks to establish baseline risk levels, evaluate the effectiveness of existing risk mitigations, and identify additional risk intervention strategies to further reduce risk in the port / waterway.

The **first step** (workbook 1) in the PAWSA process is for participants to discuss and then numerically evaluate the baseline risk levels using pre-defined qualitative risk descriptions for pre-defined risk factors.

The **second step** (workbook 2) is for 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 workshop process.

In the **third step** (workbook 3), participants discuss existing risk mitigation strategies, evaluate how effective the mitigation strategies are at reducing risk, and determine if the risks are well balanced or not.

Finally, for those risk factors where risk is judged to be not well balanced by existing mitigations, participants use workbook 4 to identify additional risk intervention strategies and evaluate how effective those new strategies could be at reducing risks.



Section 2: 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 Waterway Risk Model, risk is defined as a function of the probability of a casualty and its consequences.

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

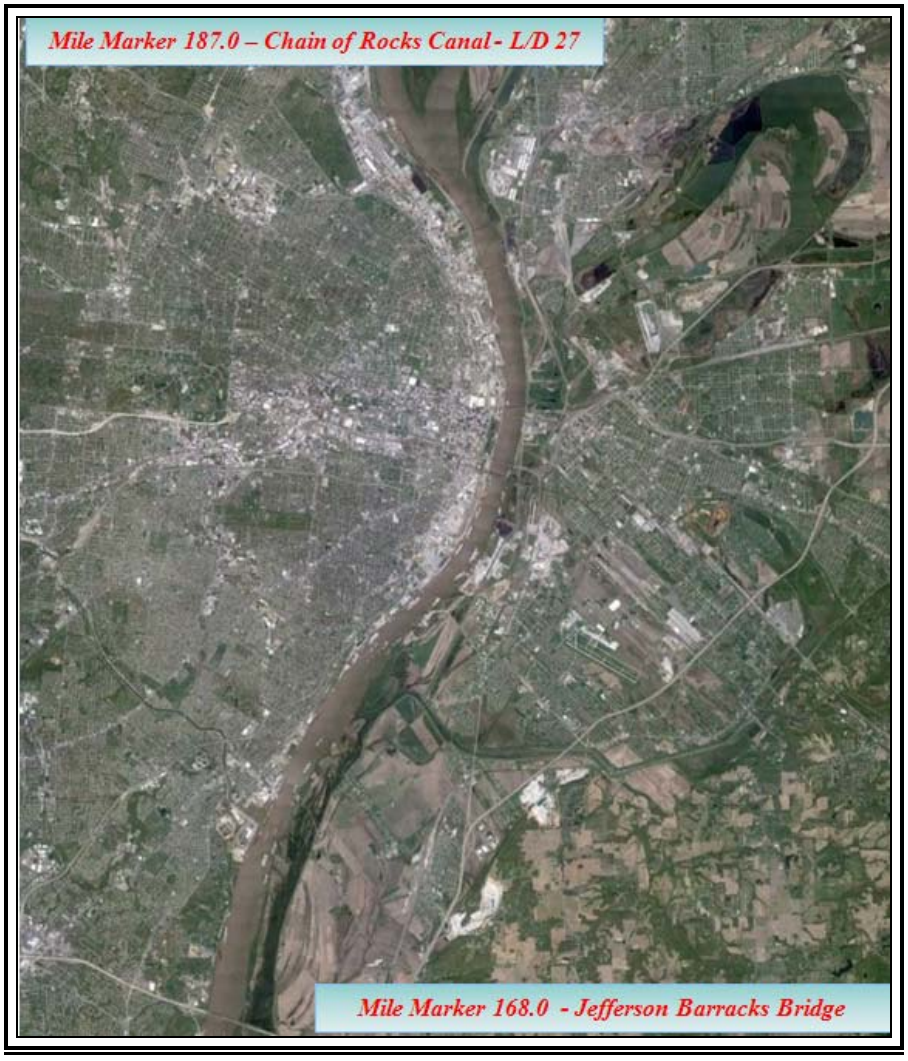
Section 3: St Louis PAWSA - Assessment Area

This report outlines baseline risk levels, captures workshop participant comments regarding current observations and trends in the port, and describes existing risk mitigation strategies that serve to "balance" the risks associated with each of the 24 risk factors in the Waterways Risk Model.

The geographic area assessed during the workshop included the Mississippi River from mile marker 168.0 (Jefferson Barracks Bridge) to mile marker 187.0 (U.S. Army Corps of Engineers (USACE) Lock and Dam # 27).

A separate assessment was also conducted to evaluate the possible safety of navigation impacts from a proposed fleeting area to be established in the vicinity of the Eads Bridge and the Martin Luther King Bridge at mile marker 180.0. Section 7 of this report outlines the results of the fleeting area assessment.

Figure 2



Section 4: Book 1 – Establishing Baseline Risk Levels

The first step in the PAWSA process (completion of workbook 1) is to determine a baseline risk level value for each risk factor in the Waterway Risk Model. To establish baseline risks levels, participants discussed 23 of the 24 risk factors in the Waterways Risk Mode and selected a qualitative description for each risk factor that best described the conditions in the port. As an inland river port, the Deep Draft Vessel Quality risk factor was not applicable and was not evaluated. These qualitative descriptions were converted to discrete values using numerical scales that were developed during earlier PAWSA workshops.

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 3 below shows that 13 of the 23 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.

As the participants discussed trends and observations for each of the 23 risk factors, their comments and observations were documented for inclusion in this workshop 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, appendix C includes ECS chart extracts with the plotted locations associated with the comment/observation

Figure 3

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
	7.96	2.40	7.53	7.65	8.49
Shallow Draft Vessel Quality	Volume of Small Craft Traffic	Water Movement	Dimensions	Petroleum Discharge	Environmental
3.82	1.52	8.70	7.48	4.10	2.62
Commercial Fishing Vessel Quality	Traffic Mix	Visibility Restrictions	Bottom Type	Hazardous Materials Release	Aquatic Resources
5.33	3.57	3.70	5.39	3.99	2.26
Small Craft Quality	Congestion	Obstructions	Configuration	Mobility	Economic
6.69	7.01	5.20	4.83	6.66	6.99

• Water Movement (8.70)	• Small Craft Quality (6.69)	• Shallow Draft Vessel Quality (3.82)
• Health and Safety (8.49)	• Mobility (6.66)	• Visibility Restrictions (3.70)
• Volume of Commercial Traffic (7.96)	• Bottom Type (5.39)	• Traffic Mix (3.57)
• Personnel Injuries (7.65)	• Commercial Fishing Vessel Quality (5.33)	• Environmental (2.62)
• Visability Impedements (7.53)	• Obstructions (5.20)	• Winds (2.40)
• Dimensions (7.48)	• Configuration (4.83)	• Aquatic Resources (2.26)
• Congestion (7.01)	• Petroleum Discharge (4.10)	• Volume of Small Craft Traffic (1.52)
• Economic (6.99)	• Hazardous Materials Release (3.99)	

Section 5: Book 2 – Team Expertise Cross-assessment

The next second step in the PAWSA process is the completion of a team expertise cross-assessment (workbook 2). 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 teams a sense of where everyone thought they were strong – or perhaps not so strong. 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. Overall, 41% of the participant teams were placed in the upper third, 32% in the middle third, and 27% in the lower third of all teams. While the "ideal" split is closer to a 33% / 33% / 33% distribution, the expertise in the room was strong for all six risk categories, and extremely strong in the Vessel Conditions risk category.

The following table further breaks down the participants' expertise for each risk category.

Figure 4

Team Expertise - Distribution

Risk Category	Top 1/3	Mid 1/3	Lower 1/3
Vessel Conditions	52%	27%	22%
Traffic Conditions	41%	34%	25%
Navigational Conditions	45%	28%	27%
Waterway Conditions	36%	36%	28%
Immediate Consequences	39%	34%	27%
Subsequent Consequences	34%	34%	31%
All Categories - Average	41%	32%	27%

Section 6: Book 3 – Evaluating the Effectiveness of Existing Risk Mitigation Strategies

The third step in the PAWSA process is for participants to evaluate the effectiveness of existing mitigation strategies in reducing the risk level for each risk factor. Participants discuss existing risk mitigations for all risk factors in the model, and then completed workbook 3 to evaluate how effective they thought the mitigations were at reducing risks.

For all 23 risk factors evaluated, there was consensus among the participants that risks present in the port were well balanced by existing mitigations. Consensus is defined as 2/3 of the workshop participant teams being in agreement.

Figure 5

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
	7.96 7.09	2.40 2.37	7.53 6.51	7.65 6.59	8.49 7.15
	Balanced	Balanced	Balanced	Balanced	Balanced
Shallow Draft Vessel Quality	Volume of Small Craft Traffic	Water Movement	Dimensions	Petroleum Discharge	Environmental
3.82 3.17	1.52 1.54	8.70 7.59	7.48 7.01	4.10 3.86	2.62 2.47
Balanced	Balanced	Balanced	Balanced	Balanced	Balanced
Commercial Fishing Vessel Quality	Traffic Mix	Visibility Restrictions	Bottom Type	Hazardous Materials Release	Aquatic Resources
5.33 3.68	3.57 3.26	3.70 3.54	5.39 5.30	3.99 3.97	2.26 2.24
Balanced	Balanced	Balanced	Balanced	Balanced	Balanced
Small Craft Quality	Congestion	Obstructions	Configuration	Mobility	Economic
6.69 5.95	7.01 6.72	5.20 5.11	4.83 4.73	6.66 6.38	6.99 7.34
Balanced	Balanced	Balanced	Balanced	Balanced	Balanced

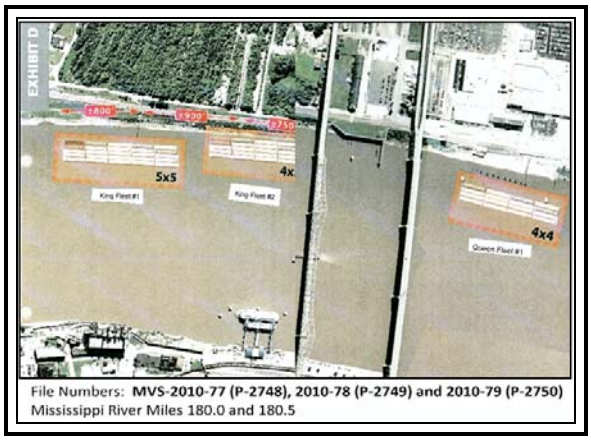
Risk Factor	
Book 1 Score	Book 3 Score
Consensus Reached ?	

	EXPLANATION
Book 1	Baseline risk level
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
Not Balanced	Consensus that existing mitigations do NOT adequately balance risk

Section 7: Proposed Fleeting Area Evaluation – Mile Marker 180.0

Reaching consensus that all risks were believed to be balance by existing mitigations, the workshop agenda allowed for additional discussions regarding a proposal submitted to the U.S. Army Corps Of Engineers (USACE), to establish three barge fleeting areas along the left descending bank of the Mississippi River. Two of the fleeting areas (King #1 and King # 2), are proposed up-stream of the Martin Luther King Bridge at mile marker 180.5. The third fleeting area (Queen # 1) is proposed down-stream of the Eads Bridge at mile marker 180.0. The below diagram is from the Public Notice released by the USACE announcing their receipt of the fleeting area proposals.

Figure 6



Participants were asked to discuss the fleeting areas and the risks they could introduce, and also identify what additional mitigation strategies could be put in place to drive down the risks. Discussions focused on the low water / high water conditions when transiting the area, navigational challenges associated with reduced waterway dimensions, how much do existing fleeting areas contribute to overall risk, and the possible impacts to safety of navigation that may arise from the proposed fleeting areas. Appendix B includes a summary of the comments and observations made by the participants during the fleeting area evaluation.

Participants were then asked to complete a separate workbook 3 evaluation (in the dimensions risk factor), and a workbook book 4 evaluation to identify additional mitigation strategies and how effective they could be at driving down the risk associated with the proposed fleeting areas.

In the figure below, the number at the bottom left (8.54) is the workbook 3 mitigated risk score. This is the risk level the participants felt would be present considering the dimensions of the proposed fleeting area, taking into account existing mitigations. The number shown at the bottom right (7.06) is the workbook 4 additional risk mitigation score. This is the risk level the participants felt could be achieved if the additional risk mitigation strategy (coordination and planning - employ 2 tugs in the fleeting area) was enacted. This risk mitigation strategy resulted in a risk reduction factor of 1.48, and was determined to be the most effective of all the strategies identified by the participants. Appendix E describes all additional risk mitigation strategies proposed by the participants during the fleeting area evaluation.

Figure 7

Dimensions Risk Factor	
8.54	7.06

Conclusion

The objective of a PAWSA workshop is to not only 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 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 St Louis's maritime community.

The United States Coast Guard, Marine Transportation System Management Directorate, extends a sincere appreciation to the participants for their contributions to the St Louis 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 St Louis.

United States Coast Guard

Marine Transportation Systems Directorate

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Appendix A

Workshop Participants and Facilitation Team

Participant	Organization	Email Address
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Appendix B

Participant Observations- Trends in the Port and Existing Risk Mitigations

Shallow Draft Vessel Quality:

Trends of today:

The quality of towing vessel, harbor fleeting tow boats, and passenger vessels in St. Louis harbor has greatly improved over the past 10 years. The towing vessels are cooperating in the USCG's Towing Vessel Bridging Program (TVBP), and approximately 80% have been examined and received a TVBP exam sticker. Although there are currently no formal inspection regulations for towing vessels, a majority of the towing vessel community in St. Louis harbor are voluntary participants in the TVBP and have been maintaining their vessels to a higher quality standard and using more modern equipment over the past 10 years. Towing vessels from the St Louis area are even being used as "examples" in the industry to show what a towing vessel that is in compliance with the upcoming towing vessel inspection regulations. Also, many of the towing vessel companies are voluntary members of the American Waterway Operators (AWO) organization which requires they meet certain high standards in order to join and retain membership. There are, however, still some non-AWO participant towing vessels operating in the St. Louis harbor. The horsepower on towing vessels and harbor boats has increased over the past 10 years.

Barge construction quality has greatly improved over the last 20 years. Continually, new barges are being built to replace their counterparts from the late 1970's/1980's which are being retired. New barges are being built with crewmember safety in mind. Barges of today have better constructed hulls and the ability to carry more cargo as compared to barges of the past. Previously, barges were only able to draw 9 feet, versus the newer barges that can draw up to 12 feet.

Passenger vessel captains and senior deck hands display longevity in their careers, some operating for 10-15 years, and exhibit excellent interpersonal relationships with vessel crews and shore side employees

Captains and Pilots have seen an increase in pay helping to extend career longevity and retain credentialed and experienced personnel. The experience levels of shallow draft vessel operations have grown increasingly better due to licensing requirements. This is a welcome change considering that in previous years one could legally operate a shallow draft vessel in the St. Louis waterways with no experience at all. There was a concern regarding the future of the Pilots in the St. Louis harbor, as most current pilots in the area will retire in the upcoming years, and there are not many recruits who are "learning the ropes". It was recommended that the port should begin recruiting younger pilots now to bridge the gap with future retirements.

Existing Mitigations:

There is an excellent partnership between the Coast Guard and local industry, and the Coast Guard presence in the area helps to create and maintain the high standards reflected in the shallow draft vessels of today. The new marine inspection requirements have caused many industry members to take a proactive stance in preparing their shallow draft vessels for compliance. Most companies are active participants in the Towing Vessel Bridging Program in order to prepare for the Subchapter M regulations. By implementing safety management systems and conducting voluntary exams risk attributed to these vessels is reduced. Previously in the Port, shallow draft vessel operating companies participated in the AWO Responsible Carrier Program which focused on crew endurance, safety, employee assistance programs, and training. Even the non-AWO operators participate in examinations (by an industry vetting program) if their craft(s) is handled by an AWO participating fleeting area operator. Local operating companies provide top notch crew training and use a more selective approach in the hiring process. Some companies require that new hires attend a mandatory two week training program before they are allowed to operate on the waterways. Excellent communication between waterway operators reduces risk in the Port. The industry community is a close-knit group who are ready and willing to help each other in the event of an emergency. With only a limited number of people operating in the harbor on a daily basis, everyone works together to keep the area and the local shallow draft vessels safe.

Commercial Fishing Vessel Quality

Trends of today:

There are only two or three commercial fishing vessels that operate in St. Louis harbor. These vessels are john boats that drag hoop nets during the morning hours. Commercial fishing vessels are larger than they were 10-15 years ago. Operators exhibit navigational skills and demonstrate a good understanding of waterway operations. These operators avoid commercial traffic and pose only a minimul safety risk in the St. Louis harbor.

Existing Mitigations:

No additional mitigations were discussed.

Small Craft Quality:

Trends of today:

St. Louis harbor sees a variety of small craft vessels that transit the waterway. Smaller vessels approach St. Louis from areas outside of the harbor as there is no marina close by. Most small craft vessels are only transiting through the waterway and there is no waterskiing or other water sports taking place in the Port. Larger yacht operators display a good knowledge of waterway operation and communicate often using the radio. Vessels measuring 20-30 feet tend to stay above St. Louis. Canoeists and rafters that are navigating downbound on the Mississippi River are a big concern. A consensus of participants concluded that it is not safe to navigate an unpowered vessel in St. Louis harbor. These small craft operators lack knowledge of the waterway and are unaware of the risks of sharing the waterway with commercial traffic. Often they are on long journey's downriver (from Lake Itasca to New Orleans) and are fatigued. Canoeists, kayakers, and rafters are more prevalent in the summer months and tend to operate during the day.

Existing Mitigations:

The Coast Guard takes an aggressive stand against unsafe operations by canoeists, kayakers, and rafters. They receive alerts from the lock/dam operators as well as commercial vessel operators if there is an unpowered small craft in the area, and will then track their transit until they are out of St Louis harbor area. If the Coast Guard is able to reach the craft in time, they will stop the operator and educate them on the risks of operating in the area and check the condition and safety of the equipment they are using. The Waterway Action Plan (WAP) restricts all recreational traffic in certain areas during highwater conditions of the waterway and requires small craft operators to call ahead to get permission to operate. Posters and literature are posted by the ACOE Rivers Project office. The American Waterway Operators also has literature available to educate small craft vessel operators.

Volume of Commercial Traffic

Trends of today:

The volume of commercial traffic in St. Louis harbor has increased over the years and is still on the rise. There are more barges loading in St. Louis, even though commercial traffic throughout the Illinois River is trending down. St. Louis is better equipped to accommodate larger draft barges, making off-loading in St. Louis desirable. Barge tonnage has also increased, especially over the past 24 months. The increase in commercial barge traffic and cargo arriving in St. Louis harbor has railroad companies looking more favorably on the area and has produced a rising demand for strategically located terminals to facilitate rapid loading and off-loading. Steel and fertilizer imports are increasing in addition to other commodities. The exports of dry distillers grain and coal have increased (Marker TC 1 - Coal facility south of Sawyer Bend), and even though ethanol shipments have leveled off, they still remain high. The boom in coal transport has some of the local barge companies switching from grain transport to coal transport. Old coal facilities are being reopened to the North and South of St. Louis; all of the mined commodities will be exported out of the local area.

Existing Mitigations:

Excellent and effective communication between waterway operators and the Coast Guard help to mitigate risk caused by the heavy volume of commercial vessel traffic. All commercial vessel operators properly utilize radio channel 13 for navigation, and fleeting boats have their own "company channel" for internal communications. Excursion boats will travel alternate spans of the bridges in order to allow commercial vessels the opportunity to continue operating on their current route and not congest the area. The majority of line haul vessels operating in the harbor voluntarily use an Automatic Identification System (AIS). The Coast Guard offers escorts to commercial vessels in times of heavy traffic and during high water commercial vessels will adjust their speed and hold up to allow other vessels to pass safely. Lock/dam #27 also helps to control the volume of commercial vessel traffic. Industry members are very proactive in dealing with periods of heavy traffic and communicate their schedules to other industry operators. The Waterway Action Plan is a working cooperative agreement between the maritime industry and federal waterway regulators, and facilitates the safe and orderly movement of traffic during extreme conditions on the inland rivers.

Volume of Small Craft Traffic

Trends of today:

Overall, there is not a large amount of recreational traffic in St. Louis harbor, even on the weekends. The Fourth of July sees an increase in recreational traffic; however, these vessels are mostly just transiting the harbor. Transient vessels, mostly yachts, travel north in the spring and south in the fall, however, they are sporadic and do not contribute to the otherwise heavy volume of commercial traffic using the waterway.

Existing Mitigations:

No additional mitigations were discussed.

Traffic Mix:

Trends of today:

Approximately ninety-eight percent of vessel traffic in the region is commercial, so there tends to be very little mix between commercial and recreational vessels in the Port. Occasionally, vessels will need to transit across the river, however, most vessel operator's stay on their side of the channel and out of the way of opposing traffic. Fleeting boats work in close proximity to their fleet only pushing one or two barges at a time and they do their best to stay out of the way of transiting traffic.

In high water stages, slow moving upbound vessels and fast moving downbound vessels have to adjust their speeds so that they do not meet each other in the waterway between the bridges, and not under the bridges which increases risk. When transiting through the center four bridges, (Martin Luther King, Eads, Poplar Street, McArthur,) upbound vessels have to maintain a speed of at least three miles per hour. Over the years, communication between vessel operators has improved; however, there are still times when communication can be an issue, especially when shore based activities, such as Coast Guard Broadcast Notice to Mariners, are being broadcast.

Existing Mitigations:

Even though there are some communication issues between vessels, communication on the river between line haul vessels, fleeting boats, and excursion vessels is timely and alerts operators to potential areas of traffic mix as soon as possible. The absence of the floating casino boats has also helped to mitigate traffic mix concerns. Daylight and nighttime restrictions (when the water level is 25 feet or higher) also reduce risk.

Congestion:

Trends of today:

It was observed that there is congestion from Lock/dam #27 all the way down to the Jefferson Barracks Bridge— or the entire geographic area evaluated for this workshop. Currently, large fleeting areas are located in the southern portion of the harbor. In the area south of the Mac Arthur Bridge, vessels come from different

fleeting areas and merge in the waterway to travel upbound (Marker TC 2 - congestion below Mac Arthur Bridge). There are no locks located downstream of the St. Louis harbor, therefore large tows of 15 barges or greater are entering the fleets below the Mac Arthur Bridge in order to change, make, and break their tows.

Jumbo barges mixed into a fleet will not allow other barges to align in a "square fleet". Some stop in St. Louis and others transit up to Chicago, but due to their size, they take up a large part of the waterway. Dredging "quarry boats" are deployed throughout the harbor on a daily basis. Construction occurring by the new I-70 bridge is also a cause of congestion. Downbound vessels over 600 feet in length are not able to transit from Lock/dam #27 to MM 178 at night if the water level is over 25 feet. This restriction causes more congestion in the morning since restricted vessels must run in the morning and then meet up with upbound tows.

Existing Mitigations:

During events occurring near the St. Louis Arch or the riverfront area, the Coast Guard will provide escorts to commercial vessel traffic and will enforce a safety zone around the event area. The traffic flow from Lock/dam #27 can be controlled to manage congestion.

Winds:

Trends of today:

Winds are predominately out of the west, from the Missouri side of the river. They are more prevalent during the spring and fall. Pop up thunderstorms are problematic as their high wind gusts are unpredictable. The effects of wind conditions on vessel transits depends on if a tow is empty or loaded. Winds of approximately twenty-five mile per hour would be the limiting factor for a vessel with an empty tow. Winds also effect vessel navigation through the bridges, especially the downtown bridges (Marker NC 1 - winds around Merchants Bridge).

Existing Mitigations:

Wind forecasts by the National Weather Service are reliable and issued daily. During extreme weather conditions, the Coast Guard will put out broadcasts notifying mariners of high winds and unfavorable weather conditions. Mariners also monitor radio channel 13 for high wind and extreme weather reports from fellow mariners. Many vessel operators have marine radios onboard with weather channels for receiving wind forecasts and weather reports. Shore side operations also monitor the wind and weather conditions via real time internet and will report updates to vessel operators.

Water Movement:

Trends of today:

Allisions tend to be greater when the water level is high, and groundings increase when the water level is low. Wet and dry years vary leaving the water level dependant on weather conditions as well as the area from where the water is coming. High water can occur year round and is not dependant on individual seasons, although the river tends to overflow following a large snow melt or heavy rain up river. The newly added chevron dikes have provided the intended scouring affects thought out the downtown area. (Marker NC 2 – chevron dikes north of Merchants Bridge). It was also advised that as vessels depart the Chain of Rocks canal (around MM 180) they need to monitor the powerful currents that are present throughout St Louis harbor.

Existing Mitigations:

The St. Louis river gauges, and twice daily Coast Guard broadcasts of river conditions, help reduce risk caused by waterway movement. Local Captains and Pilots have experience operating in extreme high water conditions (over 25 feet) since it is a reoccurring event. The Waterways Action Plan is reviewed annually and also triggers specific actions when high water events occur. Vessel operators and shore side personnel track water movement using electronic devices and internet updates. Daylight hour only restrictions, barge restrictions (reducing the number of barges in a tow or amount of horsepower), and reducing and the size of fleets can also help to mitigate risks. The River Industry Action Committee (RIAC) is an extremely proactive organization that holds frequent conference calls attended by members of industry and the local Coast Guard. The committee meets to discuss additional mitigations to reduce risks associated with water movement.

Visibility Restrictions:

Trends of today:

Fog affects navigation in St. Louis harbor approximately 20-30 times per year. It occurs mostly in the spring and fall when air temperatures and water temperatures change, and tends to be worse at night. Snow and rain squalls can also effect vessel operations. Fleeting boats will continue to operate during foggy conditions, unless visibility is less than 400 feet. Larger vessels will halt operations when visibility is less than a mile. Operations in fog are also dependent on tow size and the direction the vessel is going. For example, when traveling downbound, a half-mile of visibility may be insufficient, however, when traveling upbound, a quarter-mile visibility may be sufficient

Existing Mitigations:

The use of an Automatic Identification System is helpful in foggy conditions. When there is a heavy concentration of vessels displaying an AIS signal, precise vessel locations can be difficult to determine. Operating restrictions are imposed according to tow size and direction of movement which helps to mitigate risk. There are also propulsion horsepower requirements for towing vessels which helps to mitigate risk in high water conditions.

Obstructions:

Trends of today:

Ice and drift are the most prevalent obstructions for both fleets and vessels in St. Louis harbor. Drift can be a major obstruction in a rising river, especially on a fast rise. The drift is comprised mostly of washed out trees and can occur at any time of the year. Fleeting boats have difficulty putting a tow together when drift or ice obstructs the waterway. Ice never tends to be one solid mass; it is usually sizeable pieces of flowing, floating ice. There are several sunken barges and ships on the edges of the waterway that can be obstacles when navigating a vessel. The fleeting areas themselves are obstructions in the waterway. When the water level is high, the newly added chevron dikes are hidden below the water line and are not marked, creating an unseen obstruction in the waterway.

Existing Mitigations:

From posting broadcasts on industry bulletin boards, issuing a Notice to Mariners broadcast four times a day, holding conference calls with industry, and performing Coast Guard Auxiliary patrols of the waterway to identify obstructions, the local Coast Guard is very active in alerting waterway users to obstructions in the harbor. The Coast Guard also reviews the Waterway Action Plan annually with USACE leaders and industry stakeholders. There is also a weekly navigational channel report from the Army Corps of Engineers that highlights Navigation Safety Notices, construction updates, locations of dredging operations, shallow water locations, and upcoming dredging operations.

Visibility Impediments:

Trends of today:

Groundings occur off of Arsenal Island due to poor visibility around the curve north of the island (Marker WC 1). The fleets in the area block the view of downbound vessels, and can cause distractions to small craft operators if the fleeting boats are performing night work and have their lights on. The majority of line haul vessels in the area have AIS; however, the harbor towing vessels do not. At times, vessel traffic will “hold up” in the area which increases the risk of an allision.

There is a natural bend in the river north of the MLK Bridge which blocks the vision of downbound vessels (Marker WC 2 - north of MLK Memorial Bridge). An abundance of background light comes from the city, the docks, and affects downbound vessels more than upbound vessels. Reduced visibility due to background lighting begins for upbound vessels around MM 178, and around MM 183 for downbound vessels (Marker WC 3- lighting impediments). During high water conditions, the Eads Bridge structure can block an

operator's view of the waterway when they are located directly below the bridge. Also, when a vessel is north of the Eads Bridge, it is difficult to see the full channel span. The waterway near the Arch is also an area where visibility may be compromised.

In the vicinity of the Chain of Rocks canal, vessels traveling in both the river and the canal are sometimes not visible to each other due to the levee, especially during low water conditions (Marker WC 4 - levee in Chain of Rocks canal). There is a temporary issue with lighting resulting from the new I-70 bridge construction; however, this impediment will be removed once the bridge construction is complete.

Existing Mitigations:

Several structures have reduced or removed lighting in order to lessen the impact of background lighting on visibility in the area. Lighting from the I-70 bridge construction was reduced after complaints were made; and the special navigation lighting marking the center span of the Eads Bridge is no longer lit at night. The Army Corps of Engineers along with RIAC and the Coast Guard are proactive in identifying potential lighting disturbances before lighting permits are issued. Also, the levee on the East St. Louis side of the Mississippi River extends up to the sea wall which helps to reduce visibility impediments caused by background lighting.

Dimensions:

Trends of today:

Larger tows coming up the river may have difficulty when passing or meeting other vessels in the waterway. During lower river conditions, the shoaling is marked by green buoys below MM 176. Large upbound line haul vessels usually moor their barges in the Fleeting Areas and then depart

Between mile markers174 to around 180, one-way traffic is common, however, not required. At times vessels will overtake slower moving vessels in the waterway near the downtown area which can be narrow and risky (Marker WC 6 - overtaking of a vessel north of Poplar Street Bridge). Upbound traffic will "hold up" on buoy #9 to allow downbound traffic to pass since downbound traffic has the right of way. Traffic is easily able to meet at MM 178.5 or at MM 180 between the Eads and Poplar Street Bridges.

Vessels can utilize either the main channel or Illinois span during all water stages with a full 15 barge tow if necessary. For vessels traveling downbound, the center channel span of the Eads Bridge is the preferred travel route. The Eads Bridge also provides limitations to vessel operators because of the arch design of the bridge. The Eads Leading Light helps captains and pilots line up to transit through the center of the Eads Bridge. Even though the Merchants Bridge is lower, it is not as limiting as the Eads Bridge. The span was never blocked by the casino; most operators chose not to run the Illinois span for general safety concerns with the moored vessel in the vicinity.

If necessary, small passenger vessels can run outside of the preferred channel north of the Eads Bridge, and can operate on both the Missouri and Illinois sides of the waterway. Fleeting boats prefer to use the Illinois side of the river when traveling upbound.

The construction of the new I-70 bridge has created dimensional issues. The new bridge construction has eliminated a "hold up" location which presents difficultly with getting into and out of the dry cargo docks (Marker WC 7). Merchants Bridge is low to the water which requires some vessels to remove or lower their radio antennas before they can transit underneath (Marker WC 8). Large tows are unable to meet between the Merchants and McKinley Bridges as the new chevron dikes makes meeting in this area dangerous (Marker WC 9). Vessels have to "hold up" when there is vessel traffic transiting downbound out of Lock/dam #27.

Existing Mitigations:

Restricted areas throughout the waterway prevent vessels from meeting (i.e., between Merchants and McKinley Bridges) which reduces risk. There are new river channel control measures being implemented which will also help to improve waterway dimensions. The USACE has assured that the chevron dikes installed around MM 181 will increase water velocity and scour the river floor and bank line that will maintain a channel dimensions of nine feet deep by 350 feet wide (Marker WC 10).

Bottom Type:

Trends of today:

The bottom type is mostly mud and sand throughout the harbor. It was noted that the bottom type is all sand out by Arsenal Island and that if a lead barge of a tow runs up on a shoal there, it could "top you around." Shoaling areas can be found from the Jefferson Barracks Bridge to Arsenal Island. The canal produces bank suction along the edges of the dredged channel and suction is most prominent above the Merchants Bridge (Marker WC 11). The Chain of Rocks canal is mostly made up of rock bank.

Existing Mitigations:

The Army Corps of Engineers posts online surveys in order to determine areas of the waterway that need dredging or attention. Industry can also report areas of problematic bottom type to either the Army Corps of Engineers or the Coast Guard.

Configuration:

Trends of today:

There is a convergence of traffic located between the Merchants and McKinley Bridges near the Chain of Rocks area (Marker WC 12), and at the end of Lock/dam #27. The bend going into the Chain of Rocks canal is the narrowest in the channel and vessels are unable to meet in the entrance (Marker WC 13), however, they are able to meet further up the canal. From MM 179 south there is crossing-traffic involving all type vessels (Marker WC 14). This cross-traffic can occur at any time of day and at times extends north of MM 179. Docks and fleets are positioned throughout the harbor which can cause risk to a mariner who is unfamiliar with the waterway configuration.

There are also approximately 35 total vessels (mix of linehaul, harbor tugs and small boats) and approximately 1,000 barges in operation in the harbor at any given time. At times, radio traffic broadcasts are issued and can be misleading to other traffic operating in the harbor. Shallow water in the area can also cause additional risk.

Existing Mitigations:

Local mariners have a good general knowledge of the waterway configuration and have excellent communications with other members of industry. Fleeting boats utilize radio communication before crossing the river in order to give the line haul boats advanced notice of their transit. Announcements made on channel 13 also alert mariners to the movement of downbound traffic transiting from the McKinley Bridge, through the Eads Bridge to the terminal on Margaret Street. Some vessels have Automatic Identification Systems (AIS) onboard; however, the observation was made that if AIS is put on fleeting boats, it may be more of a hindrance than a help.

Personnel Injuries:

Trends of today:

There was a successful evacuation of a casino boat in 1998 in which 2,600 passengers were safely evacuated off of the vessel with no injuries or casualties. The largest passenger vessel operating in the harbor carries a maximum of 350-375 passengers. These vessels mostly transit the center span of the four bridge areas, which are the most dangerous areas of the waterway; however, they are able to operate safely. If necessary, passenger vessels typically are routed out of the way of commercial traffic. Commercial operators typically know the passenger vessel schedules and routes and plan their transits accordingly.

Existing Mitigations:

Passenger vessel companies conduct crew training, safety checks, emergency drills, and security drills on a regular basis. Passenger vessel operators and crews are CPR and first aid certified. They are members of the Passenger Vessel Association and have a rigorous inspection program for their vessels. The Waterways Action Plan is also used to mitigate the risk of personnel injuries. Excellent communication and coordination with other mariners is an additional mitigation reducing personnel injury risk.

Petroleum Discharge:

Trends of today:

The arrival of oil barges in the Port has increased over the years. Oil is carried mostly by 300 feet by 54 feet double hulled barges. There are new ethanol facilities in the area, and crude oil loading by pipeline is predicted to increase which will add to the volume of downbound traffic transporting carrying oil. To date, there is a great amount of liquid cargo transiting the harbor. Several fueling facilities are located along the river bank and around Wood River Bend, and are used to fuel fleeting boats. These facilities pose a risk of spilling oil either midstream and/or dockside. There is also the risk of an oil barge hitting a bridge. Most towing companies try to not mix grain and oil barges in a tow, however, some carriers still carry mixed tows.

Existing Mitigations:

The Marine Transportation Security Act regulations and Facility Security Plans require a 24-hour notice of arrival for oil barges transiting the waterways. If a carrier is hauling a mixed tow, the oil barges are usually arranged in the center having other cargo barges form a protective barrier around them. Line haul vessels will stay with the petroleum barges until their cargo is offloaded. The majority of the liquid cargo operations occur in the Wood River area.

Hazardous Materials Release:

Trends of today:

St. Louis harbor has seen an increase in ethanol barge transits over the last few years. Anhydrous ammonia barges also transit the waterway up to Wood River. There are no hazardous material facilities in the downtown St. Louis harbor area. The majority of hazardous material transits are transported in unit tows, not mixed tows.

Existing Mitigations:

When in transit and in a mixed tow, the certain dangerous cargo barges are usually located in the middle in order to lessen the risk of a release in the event of a collision or allision.

Mobility:

Trends of today:

In the past, the river has been closed briefly; however, these closures did not extend for a lengthy amount of time. It was observed that even when barges have allided with bridges, traffic has continued to safely operate in the waterway. Previous experience has shown that the waterway remained open even when there were obstructions. Mobility in St Louis harbor would depend upon where in the waterway the blockage occurs as well as the water conditions. For example, upbound and downbound traffic would be stopped if there was a closure at Lock/dam #27 (Marker IC 1). The largest risk to mobility in this area would not necessarily be a blockage in St Louis harbor, but rather a failure of the Lock/dam itself. The most probable incident that would shut down the lock is a vessel alliding with the lower miter gate of Lock/dam #27. Recently the lock/dam area was shut down for 30 days due to scheduled repairs.

Existing Mitigations:

There is excellent communication and cooperation between industry and the Coast Guard. The relationship between government entities and industry allows for quick innovative thinking and swift action. All available towing vessels in the port are willing to assist in the event of a scattered tow and Coast Guard is able to set up a safety zone around an obstruction to help prevent further damage. One-way traffic could also be instituted to help mitigate risk and maintain traffic flow. Electronic location equipment (such as sonar) could be used to determine a sunken obstruction's location. There is one local salvage company available in St. Louis that may be able to react immediately. Overall, the preventative measures greatly reduce the risk of a mobility issue.

Health and Safety:

Trends of today:

There is a large population of people in the downtown area which increases greatly during sporting and special events (Marker SC 1). Local special events, including baseball games, can bring in populations upwards of 200,000 people. The downtown area hotels are not located directly next to the water; however, they are close enough that they would be affected by a prevailing wind carrying airborne hazardous materials.

Although there is no waterfront hazardous material facilities in St. Louis harbor area, there are still hazardous cargoes such as anhydrous ammonia and ethanol that transit the water and create risk.

Existing Mitigations:

Following the events of 9/11, there has been more awareness and discussion in the port regarding the health and safety of the local population. Mandated plans have been established and an Emergency Operations Center has been outlined and is ready to form when an event occurs. The local fire department has specially trained hazardous material units that are equipped with the necessary gear and training in case of a hazardous material release.

Environmental:

Trends of today:

St. Louis harbor area is not considered a "highly sensitive" environmental area. The river is used mainly for industrial purposes; however, vessel operators have a much larger environmental awareness now than they did in the past.

Existing Mitigations:

The MACPS denotes environmentally sensitive areas in the harbor. The river industry and community at large has a large awareness of the environmental sensitivity issues of the area and have helped to clean up the harbor over the past 20 years. Water quality is now monitored by the St Louis Sewage District.

Aquatic Resources:

Trends of today:

St. Louis harbor is home to fresh water mussels, clams, and rough fish. Most of the seafood is harvested further upriver and not in the St. Louis harbor. Commercial fishing occurs more upstream and downstream; meaning potential oil or hazardous cargo spills could affect fishing down river.

Existing Mitigations:

No additional mitigations were discussed.

Economic:

Trends of today:

A port closure of four days would be difficult but manageable; however, a closure of seven or more days would be economically disastrous. The harbor is sometimes closed for a few days due to unfavorable weather conditions, so a three-four day shutdown would not be uncommon. It was expressed that it would take months for the Port to fully recover from a significant closure event and return to a normal operation schedule. Locations upriver would be largely effected since they do not have year round transports, making the time of the year a factor in determining the significance of the event.

In the event of a long term port closure, the entire country would feel some effect as we are all dependent on the inland waterway barge traffic. There is also the potential for a vessel to allide with and knock

out one of the many bridges in the St. Louis area, which in turn could stop road or rail traffic. Damage to the Poplar Street Bridge would be the most devastating in terms of stopped road traffic. A gate failure or shutdown of Lock/Dam #27 would be the most significant event on the St. Louis waterway that would cause the biggest loss to the local economy.

Existing Mitigations:

The Coast Guard Marine Transportation System Recovery Unit (MTSRU) helps to train, exercise, and plan for waterway incidents that could potentially halt traffic and affect the economy. The Coast Guard Maritime Security Risk Analysis Model (MSRAM) process also helps to assess potential economic impact scenarios. Exercises help industry to prioritize cargo.

New backup miter gates are currently being manufactured for Lock/Dam #27. There are also a large number of bridges that connect Missouri with Illinois so that road traffic could be rerouted if necessary. The Poplar Street Bridge has had several allisions to date and has not showed signs of structural damage or required road closures.

Proposed Fleeting Area Evaluation – Mile Marker 180.0

Participant Discussions/Observations:

The fleeting areas could potentially impact vessel meeting situations between the Poplar Street Bridge and the Eads Bridge, forcing an upbound vessel to hold up when there is a large amount of downbound traffic, as is now the case in many locations on the river. In addition to congestion, the proposed fleeting areas could also cause a potential safety issue by effectly blocking the Illinois span of the Eads Bridge. Downbound vessels usually increase their speed to approximately 13 miles per hour in this area to make headway through the Eads Bridge.

The potential displacement of water (surge) created by large tows could cause significant strain on the moorings and lead to barge breakaways from the fleeting area similar to all of the other bank fleets on the river. A breakaway at the proposed King or Queen fleeting areas could produce a "domino effect" of breakaway barges affecting the fleeting areas south of the bridges and potentially sink barges.

Up-bound vessels sometimes use the Illinois span of the Eads Bridge because it is the slackest current available and they are able to make the best time through the bridge. By using the Illinois side, vessels are able to better align themselves through the bridge during any stage, and it was observed that it could be a safety issue to have this span unavailable for vessels to utilize. There have also been times in the past when the water level in the center of the River was so low that vessels had to use the extreme sides of the river to operate, however the USACE has concluded that recent river engineering upstream will provide a continuous naviagation depth of 9ft center channel.

With the addition of the proposed fleeting areas, the Illinois side of the River could be un-navigable (from a safety perspective) for a 15 barge upbound tow and would leave less room for meeting situations, similar to when the Casino Queen was moored in that location. It was stated that the waterway should have navigable dimensions of 300 feet wide by nine feet deep throughout the entire area, and that these dimensions will be maintained even with the addition of the proposed fleeting areas.

The proposed fleeting areas should not affect visibility for larger vessel operators because the height of the wheelhouse gives a better sight advantage; they could potentially impede the vision of smaller craft and pleasure craft operators. There are day and night visible markers on the Eads Bridge that alert tows of the arched bridge shape.

There is a significant amount of shore side development activity slated to occur above the Poplar Street Bridge in the upcoming years. This activity includes the addition of new facilities 2,000 feet north of the proposed fleeting areas, expansion of the Venice docks, and installation of a new Tiger ramp below Lock/dam #27. If the proposed fleeting areas are added and the anticipated projects are completed, the number of available towing vessels working this section of the river will increase and the proposed fleeting areas will become the "first line of defense" for activities occurring above the Poplar Street Bridge.

It was questioned if tank barges would be included in the proposed fleeting areas as this could cause potential personnel injuries and pose a greater threat to the downtown area. A review of the USACE public notice indicated that no explosives or hazardous materials would be positioned within the proposed fleeting areas.

Participants expressed views that the proposed three fleeting areas would add to the "gauntlet of fleeting areas" that upbound vessels already have to transit past, leaving them little room to hold-up in the event of an emergency. Participants also expressed views that risks could be reduced by the new fleeting areas because the fleeting area staging vessels would be able to intercept breakaways, from docks and fleeting areas above the Eads Bridge, before they reach the Eads and Popular bridges and the fleeting areas south of these locations.

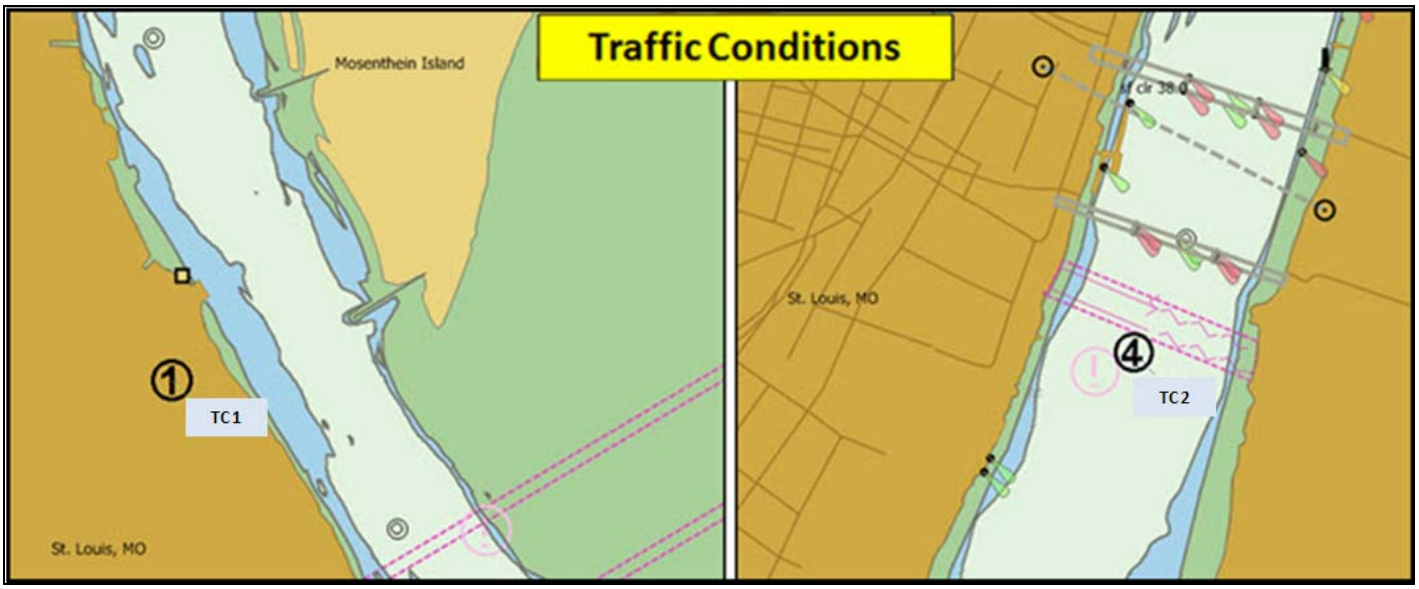
Comments were also offered that establishing fleeting areas in this location may reduce the amount of traffic in the harbor because barges will be staged closer to their destinations.

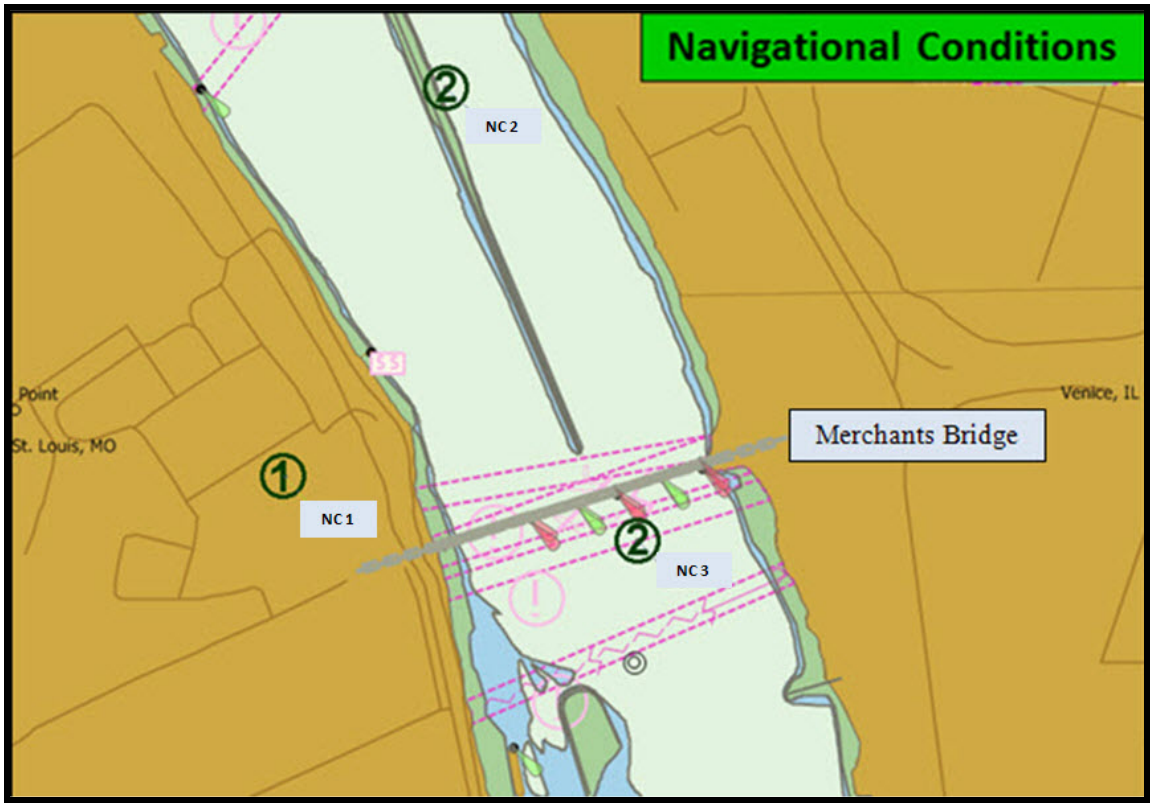
Appendix C

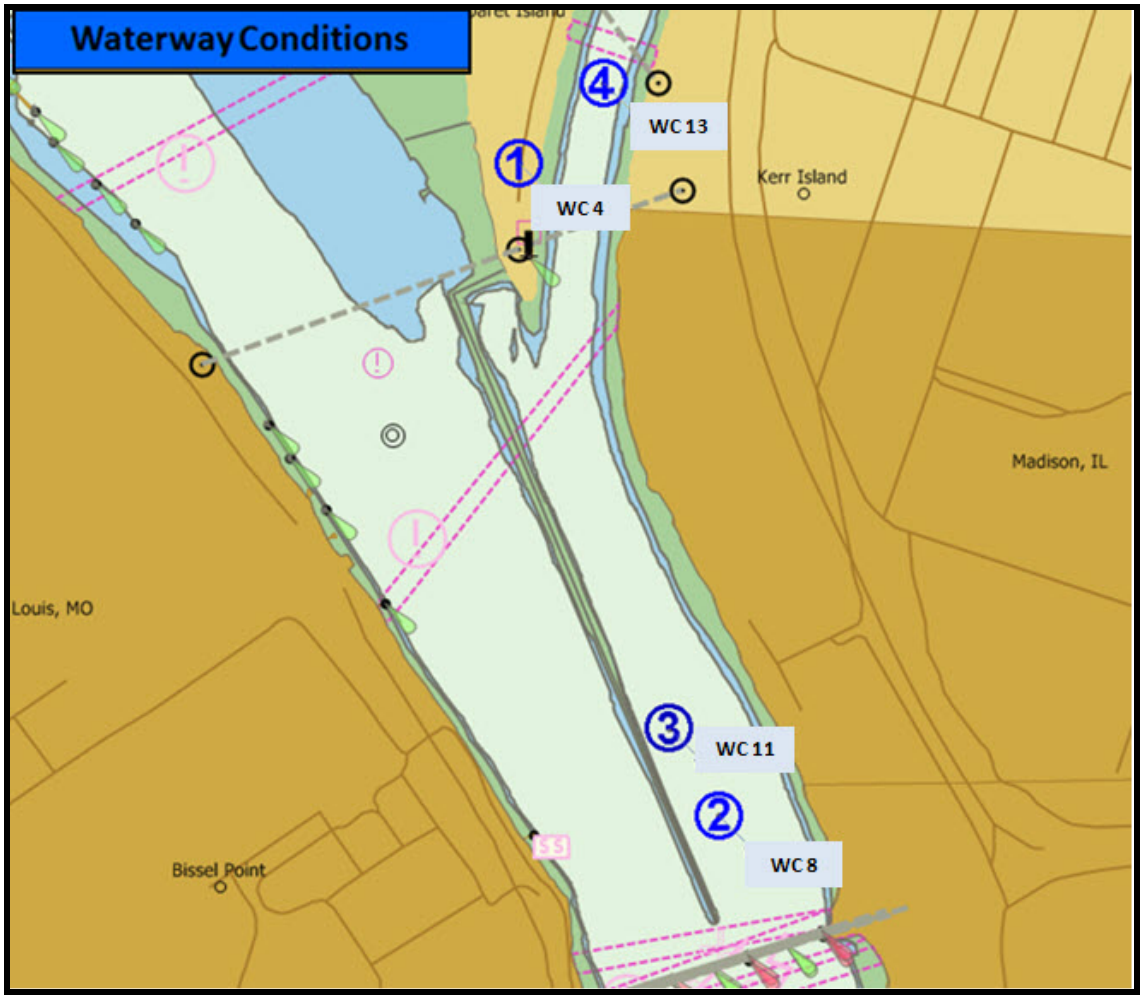
ECS Risk Factor Locations

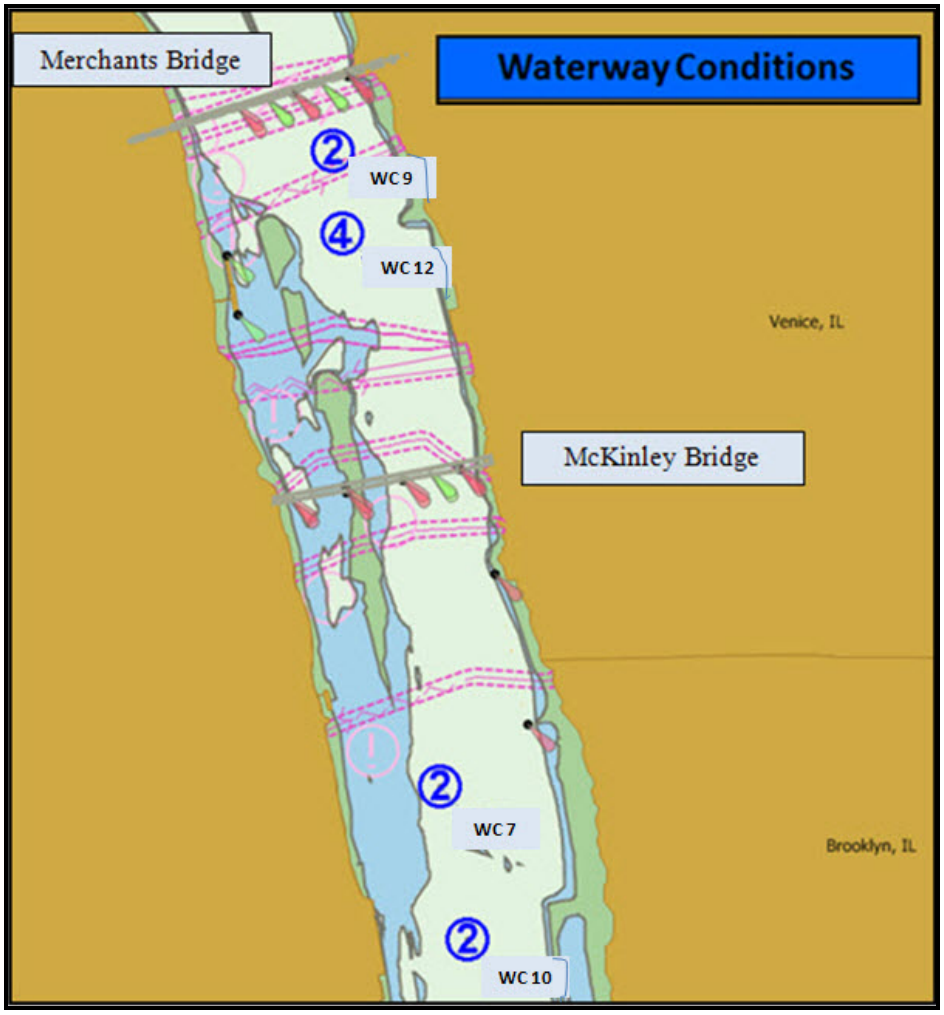
Legend

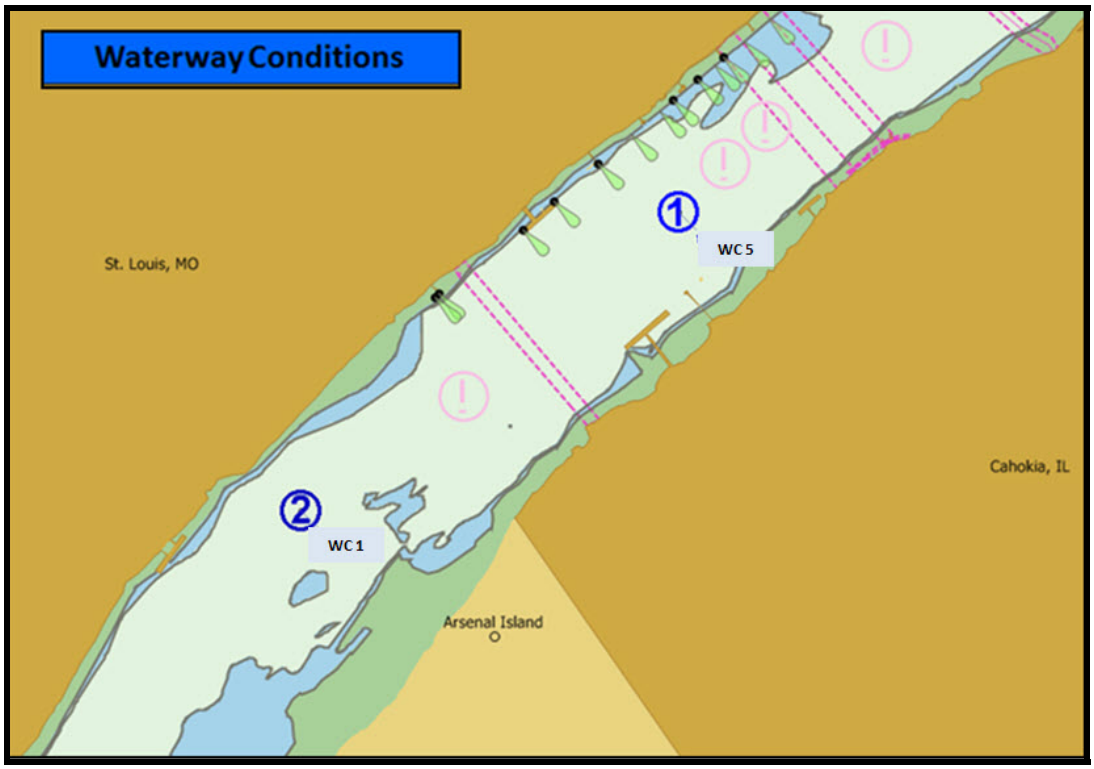
Vessel Conditions		Traffic Conditions		Navigational Conditions		Waterway Conditions		Immediate Consequences		Subsequent Consequences	
1	Deep Draft Vessel Quality	1	Volume of Commercial Traffic	1	Winds	1	Visibility Impediments	1	Personnel Injuries	5	Health and Safety
2	Shallow Draft Vessel Quality	2	Volume 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

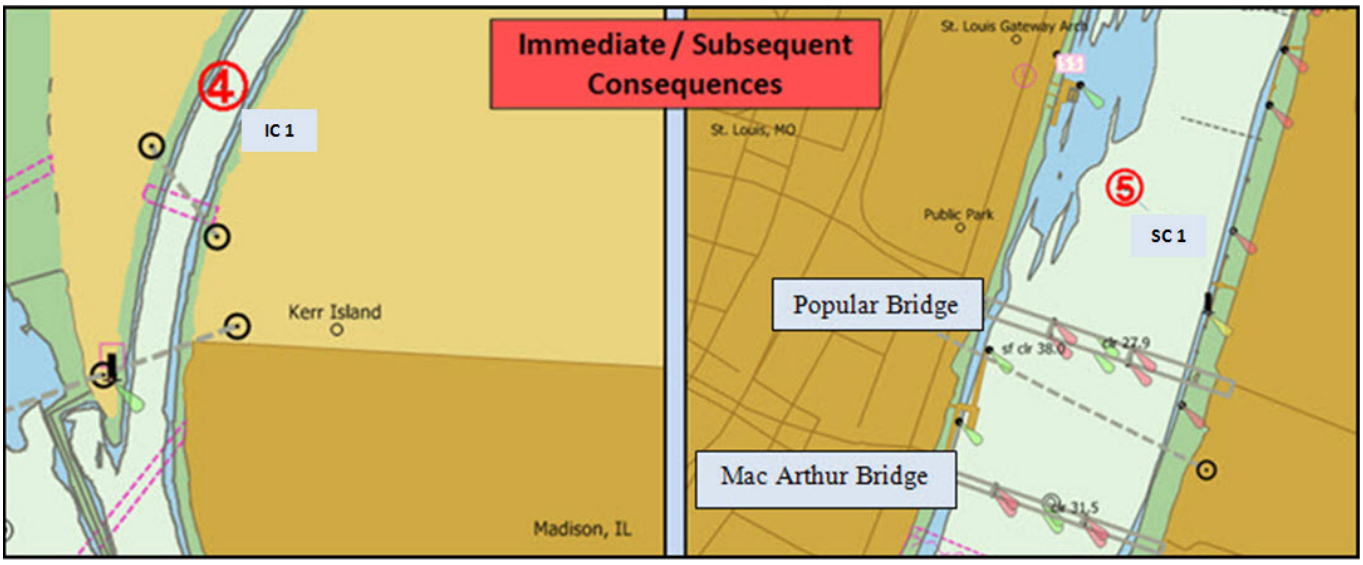



Navigational Conditions
NC 2
Point
St. Louis, MO
Venice, IL
Merchants Bridge
NC 1
NC 3


Waterway Conditions
WC 13
Kerr Island
WC 4
Madison, IL
Louis, MO
WC 11
WC 8
Bissel Point


Merchants Bridge
Waterway Conditions
2
WC 9
4
WC 12
Venice, IL
McKinley Bridge
2
WC 7
Brooklyn, IL
2
WC 10


Waterway Conditions
1
WC 5
St. Louis, MO
Cahokia, IL
2
WC 1
Arsenal Island


Immediate / Subsequent Consequences
4
IC 1
Kerr Island
Madison, IL
St. Louis Gateway Arch
St. Louis, MO
Public Park
5
SC 1
Popular Bridge
sf clr 38.0
clr 27.9
Mac Arthur Bridge
clr 31.5

Appendix D

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.).
Nav / Hydro Info	Improve navigation and hydrographic information (Notice to Mariners, charts, Coast Pilots, Light Lists, Automatic Identification System (AIS), tides and current tables, etc.).
Radio 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 E

Proposed Fleeting Area Evaluation – Mile Marker 180.0

Additional Risk Intervention Strategies

The numbers listed next to each risk intervention strategy represent the number of participant teams who voted for that particular risk mitigation strategy.

Coordination/Planning

- Employ two fleeting boats at a time in order to always have a fleeting boat available in an emergency situation. (6)

Rules & Procedures

- When a vessel is transiting downbound, have the 24/7 fleeting boat on stand-by to assist. (1)

Navigation/Hydrographic Info

- Add a visual navigational aide to help towboat operators line up accurately and navigate safely through the bridges. (3)

Active Traffic Management

- Impose a one-way traffic restriction from below the Mac Arthur Bridge to L/D #27. (3)

Waterway Changes

- Remove the remaining infrastructure in the waterway from the Casino Queen in order to move the proposed Queen fleet closer to the Illinois bank line. (1)
- Move fleeting areas closer towards Illinois. (3)

Other Actions

- Reduce the width of the Queen **and** King #2 fleets to allow more room for vessels to operate on the Illinois side. (3)
- Eliminate the Queen and King #2 fleeting areas. (3)
- Reduce width of the King #2 fleeting area. (1)