Assessing the Impacts of Hurricane Sandy on the Port of New York and New Jersey's Maritime Responders and Response Infrastructure

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This report presents the results of an academic study. The views contained herein are solely those of the author and do not necessarily reflect the views of the Center for Maritime Policy & Strategy, U.S. Coast Guard, Department of Homeland Security, or any other agency or department of the U.S. Government.

I. Overview and Study Objectives

To achieve coastal community resiliency in the face of rising seas and intensifying coastal storms, comprehensive disaster planning must include consideration of maritime operations and facilities. Key maritime operations and facilities include maritime first responders, such as U.S. Coast Guard and harbor units of police and fire departments, as well as waterborne commercial marine transportation system (MTS) and waterborne passenger transportation operations and infrastructure. While MTS resilience is often described in economic terms (e.g. Mansouri et al. 2010), maritime commerce often provides access to "lifeline" products and services to communities, such as gasoline and home heating oil, and are priority maritime response considerations. As such, "maritime response" here refers to any efforts to restore critical maritime functions and services or to use maritime infrastructure to facilitate response and recovery in some other way.

Hurricane Sandy, which hit the Port of New York and New Jersey ("Port") area on October 29, 2012, caused disruptions to maritime operations and facilities throughout the Port, which spans both the New York and New Jersey sides of New York Harbor (*see Figure 1 below and Figures 2 and 3 in Appendix*). Anecdotal evidence in the aftermath of the storm indicated that numerous maritime facilities, including facilities supporting response activities, had been severely damaged, and that response and recovery activities may have been disrupted or delayed. These anecdotes provided the initial impetus for this study, which sought to assess these disruptions and identify associated "lessons learned." As post-storm recovery is often considered a "window of opportunity" for improved hazard mitigation and planning for future events (see e.g. Platt 1998), this study sought to gain input from maritime responders and facility operators who had been directly involved in the storm, during the early stages of the post-storm recovery process, in order to identify lessons learned that may inform future planning for coastal storms as well as the long-term threats of climate change and sea level rise.

This study is shaped by two primary research objectives: (a) to identify "lessons learned" from Hurricane Sandy that can inform the maritime community's planning for future storm events and the long-term threats of climate change and sea level rise, both in the Port of New York and New Jersey and elsewhere, as noted above; and (b) to enable the researcher to lay the groundwork for a larger-scale, longer-term study of coastal storm, port resilience andclimate change adaptation planning in the Port. This report summarizes the scope, methods, and findings of research conducted using funds provided by the University of Colorado Natural Hazards Center Quick Response Grant Program. Findings include a

discussion of some key lessons learned, outstanding questions, and areas for future research that are relevant to the Port of New York and New Jersey and other ports and harbors.

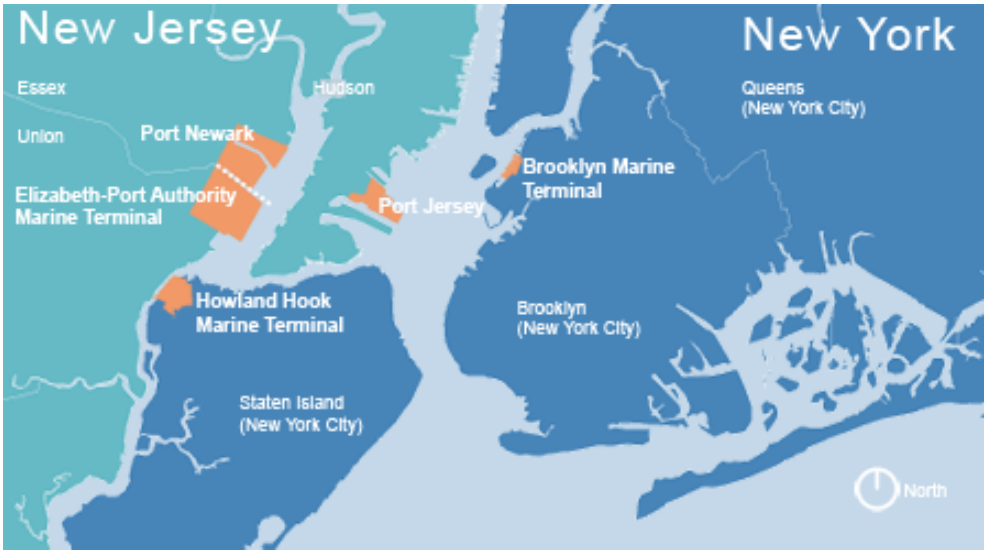

Figure 1. Map of the Port of New York and New Jersey (PANYNJ n.d.)

II. Methodology

Research methods comprised the following steps: (a) initial scoping conversations and meetings with colleagues at U.S. Coast Guard Sector NY (SECNY); (b) identification of key informants in collaboration with SECNY; (c) data collection, including participation at key meetings and semi-structured interviews with available key informants; and (d) transcription and qualitative analysis of interview content.

Initial Scoping: Initial scoping discussions and meetings were first held with Coast Guard SECNY to discuss study objectives and potential key informants to be interviewed. As a result of these conversations, study parameters were adjusted to address the potential sensitivity of information that could be disclosed. The researcher agreed to allow SECNY and port partners who were interviewed to review all research products prior to publication or dissemination; and, rather than photograph facilities as indicated in the original proposal, to only utilize photos provided by informants. Additionally, research objectives were adjusted to encompass the wide range of maritime response functions that are priorities in the Port. Initial study objectives focused on the maritime *first responder* community, including the Coast Guard as well as police, fire, and other responders. However, discussion with SECNY highlighted MTS recovery as a key response priority in the Port, and the major MTS impacts caused by this storm event. For this reason, the scope of the study was broadened to include these priorities.

Identification of Key Informants: In collaboration with SECNY, key individuals and organizations were identified for inclusion in this study using a purposive sampling method (Bernard 2011). More contacts were identified than could be interviewed within the constraints of this research grant. Priority was placed on representatives of public organizations which had been directly involved, in some form, in port or maritime response and/or recovery; additional names have been retained for inclusion in the study's proposed second phase. Ultimately, 16 individuals from 9 different organizations were included in this study. Only one organization, the NYPD, declined to participate.

Data Collection: Data collection comprised participant observation at two invitation-only meetings involving SECNY and port partners, and interviews with key informants. Participation observation was conducted at a January 30th meeting of the Port's Area Maritime Security Committee (AMSC), and at a March 21st "Regional Port Community Leaders" meeting convened by SECNY, both of which involved discussion of the Hurricane Sandy response and recovery. 13 interviews were conducted with a total of 16 individuals (*see Table 1*). All participants were public employees with the exception of those affiliated with the Sandy Hook Pilots. All participants' organizations were directly involved in maritime response and recovery in some way, though one organization was not directly involved in maritime operations, and two other organizations sent personnel and assets to the response/recovery but do not directly manage any Port facilities. Interviews were conducted either in person or by phone and employed a semi-structured approach (Bernard 2011); informed consent was obtained from all participants. Interviews were recorded to facilitate transcription and analysis, and lasted between 45 minutes and 2 hours. All interviews were conducted between January and March 2013 and were conducted in accordance with the U.S. Coast Guard Institutional Review Board's Human Research Protection Program (U.S. Coast Guard 2011). See Appendix for interview instrument and informed consent form.

Data Analysis: All interviews (roughly 16 hours in total) were transcribed and coded using NVivo 9 qualitative data analysis software (QSR International 2011). Coding employed a "broad-brush or 'bucket'" coding method (Bazeley 2007) to identify text relevant to research questions as outlined below. Most coding sought to identify lessons learned, which constitute the bulk of this research report.

Research Questions: The research questions guiding this study were: *(1) What plans and systems were in place prior to Hurricane Sandy, and to what extent did responders need to coordinate with others, and to improvise from these plans, in order to respond to and recover from the storm?* And (2) *What lessons can be learned from Hurricane Sandy that can inform the maritime community's long-range planning for future storm events, both in the Port of New York and New Jersey and in other port communities?*

III. Context: Storm Preparedness and the Port of New York and New Jersey

The Port of New York and New Jersey: Due to their location in waterfront areas, ports and maritime facilities regularly face direct threats from coastal storm events and from the longer-term problems of sea level rise, coastal flooding, and storm intensification that are expected as a result of climate change (see e.g. Becker et al. 2013). Many of these facilities are literally water-dependent, located adjacent to waterways because they require direct access to piers, deepwater berths, and navigational channels. These attributes make ports and maritime facilities uniquely vulnerable to coastal storms. Storms and associated flooding can cause major disruptions by interrupting operations, damaging infrastructure, and causing the release of hazardous contaminants into the marine environment. For example, Hurricane Katrina caused $1.7 billion in damages to southern Louisiana ports (Santella et al. 2010). Future storms which may be associated with climate change are expected to have a disproportionate impact on the port/maritime sector due to its exposure and close links to climate (see IPCC 2012).

The Port of New York and New Jersey ("Port"), which spans both the New York and New Jersey sides of New York Harbor, is the third largest port in the U.S. and the largest port on the Atlantic coast (PANYNJ n.d.). As with other ports, this port comprises a wide range of maritime operations, facilities, and activities. These include cargo facilities; support services that facilitate cargo operations; waterborne passenger transportation; and first response services. This study focuses on a small sample of such operations with a particular focus on public entities engaged in maritime response and recovery work. See Figure 1 (above) and Figures 2 and 3 (Appendix) for maps illustrating locations of key port facilities.

- **Cargo operations** are supported by facilities including container ports, oil terminals, vehicle terminals, and other bulk and break bulk cargo facilities located on the New Jersey, Staten Island, and Brooklyn waterfronts. These facilities are not managed comprehensively under one agency or organization. The bi-state, public **Port Authority of New York and New Jersey** (PANYNJ), as a landlord port, owns some of the land hosting these facilities, while other facilities, including oil terminals, are privately owned. It should be emphasized that while the maritime commerce made possible by these facilities is economically significant (see e.g. NY Shipping Association 2011), many of the products passing through the Port support lifeline functions essential to residents and business throughout the region – for example, petroleum products passing through the Port include home heating oil and gasoline.
- **Support services** that help facilitate cargo operations include pilots who guide cargo ships in and out of the harbor, such as the private **Sandy Hook Pilots**, and government vessels and services such as those provided by **U.S. Coast Guard Sector NY** (SECNY) that help facilitate safe and secure navigation in and out of the Harbor. Other agencies which support navigation safety include the **U.S. Army Corps of Engineers New York District** (USACE), which maintains federal navigational channels, and the **NOAA Office of Coast Survey** (NOAA), which surveys and charts marine waters.
- **Passenger ferries** and terminals play a critical role in supplementing the greater New York City metropolitan area's complex transportation system, and provide critical transportation redundancy in a region of islands, bridges, and tunnels. These include the publicly-operated Staten Island Ferry, run by the **New York City Department of Transportation** (NYCDOT), which connects lower Manhattan and Staten Island, as well as numerous other privately-operated passenger ferries.
- Finally, key facilities include **maritime first responders** that support the Port as well as the greater community. These include the **U.S. Coast Guard Sector NY**, whose diverse missions also include search and rescue and law enforcement, as well as the **New York Fire Department** (FDNY) Marine Operations unit, the **New York Police Department** (NYPD) Harbor Unit, and other state and municipal responders.

Port Governance Context: Port governance – meaning the broad context shaping planning and decision-making - takes place within a complex web of multiple federal, state, and local agencies and non-governmental actors who each have jurisdiction over or a stake in port activities. Port planning and decision-making, with regard to both coastal storms and other safety and security issues, is shaped in part by two port-wide standing committees: the Harbor Safety, Navigation and Operations Committee ("Harbor Ops") and the Area Maritime Security Committee (AMSC). The Harbor Ops committee comprises broad, inclusive membership from both the public and private sectors who convene regularly to discuss a wide variety of Port and MTS safety and security matters. It is sponsored by the non-profit Maritime Association of the Port of NY and NJ; founded in 1917, it has existed in its current form since 1978 (Kelly pers. comm. 2013).[1] Many study participants are members of the Harbor Ops committee, and have been attending meetings and working together for years. The Port's AMSC was first established in 2004 pursuant to the Maritime Transportation Security Act of 2002 (P.L. 107-295), which called for the establishment of maritime security committees in the nation's ports to implement area maritime security plans. The Port's AMSC is led by the Coast Guard and its structure is shaped by this federal law. Membership is limited to those public and private actors with specific interest in maritime security issues; all study participants represent organizations which are members of the Port's AMSC.

The Port's Marine Transportation System Recovery Unit (MTSRU) is based out of a subcommittee of the AMSC. The MTSRU is a specialized inter-organizational unit, led by the Coast Guard, and is stood up only when MTS recovery is needed or anticipated. The Coast Guard first established a MTSRU in 2006,

[1] Harbor safety committees like this one are not required in all ports, though Coast Guard sectors are encouraged to help establish them (see e.g. U.S. Coast Guard 2000).

pursuant to the Maritime Transportation Security Act, in part in response to lessons learned from Hurricane Katrina about the potential impacts that MTS disruption may have on the economy and community well-being (Torres 2012). The function of the MTSRU is to facilitate the reopening of the Port and the resumption of maritime commerce in the aftermath of a disaster. The Port's MTSRU, as established during Sandy, included representatives from SECNY; agencies including MARAD, NOAA, and USACE; the PANYNJ; the Sandy Hook Pilots; private sector representatives from container terminals, oil terminals, and other port businesses; and others (Morrissey pers. comm. 2013). In the case of Hurricane Sandy, the MTSRU was stood up on October 27th, two days before the storm made landfall.

Storm Preparation, Response and Recovery Plans: Several pre-existing storm preparation and response plans provide the foundation for much of the Port's response and recovery work. Key among these is SECNY's *Hurricane and Severe Weather Plan* (U.S. Coast Guard SECNY 2012a), and its companion *Captain of the Port New York Hurricane and Severe Weather Plan for the Port of NY and NJ* (U.S. Coast Guard SECNY 2012b), which lay out the procedures by which SECNY works with port partners to prepare for and respond to a major storm event. Actions such as the setting of port-wide weather alerts, the potential decision to close the port, and coordination of communications are conducted pursuant to these plans. Other key Coast Guard plans include the MTS Recovery section of SECNY's *Area Maritime Security Plan* (U.S. Coast Guard SECNY 2009), which lays the groundwork for the MTSRU, as well as SECNY's *Continuity of Operations Plan* (U.S. Coast Guard SECNY 2012c).

Some participants referenced the federal *National Response Framework* (Dept. of Homeland Security 2008), an all-hazards plan outlining how federal agencies will coordinate emergency response. MARAD's participation in Sandy recovery was guided in part by this plan. Some organizations also described their own in-house preparedness and response plans. These include the PANYNJ and NYCDOT, which have their own written plans, some of which mirror the framework laid out in SECNY's *Hurricane and Severe Weather Plan*. However, the unusual size of this storm and extent of the storm surge required nearly all organizations involved to improvise and develop new arrangements on the fly (see discussion below).

IV. Study Participants:

As discussed above, 16 individuals from nine different organizations were interviewed for this study. Table 1 summarizes each organization, participants interviewed, relevant facilities, and the organizations' response and recovery roles:

Table 1. Study Participants

Organization	Participants Interviewed	Main/Relevant Facilities	Sandy Response/Recovery Role
U.S. Coast Guard Sector New York (USCG SECNY)	4 individuals in three separate interviews from: Contingency Planning; Response; and Prevention departments	Sector offices (Staten Island); three small boat stations (Kings Point, Staten Island and Sandy Hook); two aids to navigation station (Bayonne as well as Saugerties, outside of the Port)[2]	Response: search and rescue; marine law enforcement; marine safety. Planning and Prevention: marine transportation system recovery; maritime security
New York Fire Department (FDNY)	1 individual from Marine Operations Battalion	Three full-time marine units (Brooklyn Navy Yard, Manhattan and Staten Island)	Oversee marine firefighting in the Port, firefighting vessels, and waterfront firehouses

[2] Coast Guard Aids to Navigation Station Saugerties is managed by SECNY but is located up the Hudson River well outside of the Port.

New York City Dept. of Transportation (NYCDOT)	1 individual from the Staten Island Ferry	Staten Island ferry and terminals (Staten Island and lower Manhattan); Hart Island Ferry (Bronx); other smaller terminals used by private operators	Oversee ferry vessels, terminals and facilities
Port Authority of NY and NJ (PANYNJ)	2 individuals from Port Commerce Div. in two separate interviews	Landlord port: owner of multiple port facilities in NY and NJ	Oversee marine terminals and facilities
NOAA Office of Coast Survey (NOAA)	1 individual from the Navigational Services Division	*No facilities or vessels based in the Port; sent response vessels from elsewhere*	Conduct post-storm harbor surveys (all waterways) as participant
U.S. Army Corps of Engineers New York District (USACE)	1 individual from the District's Operations Division	Waterfront offices and vessels at Caven Point, NJ	Conduct post-storm harbor surveys (federally maintained channels) and debris removal
Sandy Hook Pilots* **private*	3 individuals in one interview	Waterfront offices and vessels at Edgewater, Staten Island	Support post-harbor surveys as participant of MTSRU; contribute as needed to port recovery
Maritime Administration (MARAD)	2 individuals in two separate interviews from Gateway New York and Emergency Preparedness office	*No facilities or vessels based in the Port; sent ships from elsewhere*	Support flow of information between MTSRU and federal DOT headquarters; support DOT's "Emergency Support Function" role pursuant to National Response Framework
NJ Office of Homeland Security and Preparedness (OHSP)	1 individual from Preparedness division	*No facilities based in the Port*	Staff NJ's "private sector desk" as part of statewide response and recovery [also interviewed because of role on AMSC and work on "port resilience"]

V. Research Findings

This section discusses research findings, focusing on lessons learned and questions to be considered moving forward, and highlights some of the storm's impacts, as well as response and recovery successes and challenges, within this context. A comprehensive listing of the many storm impacts, lessons learned, and successes and challenges is beyond the scope of this study. Lessons learned presented here are a synthesis that do not necessarily reflect the views of all the individuals and organizations interviewed for this study, and most organizations are developing their own in-house 'lessons learned' analyses.

What Happened: Sandy and Its Impacts

Hurricane Sandy made landfall in the northeastern U.S. near Brigantine, NJ on October 29, 2012. At that point the storm was a post-tropical cyclone with sustained winds of 70 knots, and was notable because of its size - the storm's diameter extended to 870 nautical miles prior to landfall. As a result it drove an enormous storm surge into the New York, New Jersey and Connecticut coastlines. The National Hurricane Center reports the highest storm surge as 12.65 ft at Kings Point, NY (western Long Island Sound), whereas record storm tides (combination of storm surge and astronomical tide) reached 14.06 ft *above* Mean Lower Low Water at the Battery (the southern tip of Manhattan) and 14.58 ft at Bergen Point West Reach (the north shore of Staten Island). Inundations (water height above ground level) on

normally dry land were 4 to 9 feet in Staten Island and Manhattan, 3 to 6 feet in Brooklyn and Queens, and 2 to 9 feet in areas of New Jersey containing port infrastructure discussed here (Blake et al. 2013).

As a result of these conditions, and in particular because of the storm duration and extent of flooding, there were extensive and prolonged disruptions to many Port activities and facilities. Much port activity was shut down for nearly a week. Pursuant to procedures outlined in the *Hurricane and Severe Weather Plan*, the Coast Guard Captain of the Port closed the entire Port to all traffic before the storm, at 6 pm on Oct. 28th. The Port was not fully reopened to marine traffic until a week later on Nov. 4th (though partial reopening began on Nov. 1st). The PANYNJ followed a similar schedule with reopening cargo terminals and related facilities. However, numerous port facilities, including container and oil terminals, did not resume full operations once waterways were open due to facility damage and loss of power. The Staten Island Ferry suspended service for five days, resuming service on November 2nd.

Areas of the Port were closed to traffic for days because the Coast Guard, NOAA, and the USACE first needed to conduct waterways surveys to ensure navigational aids were on station, marine debris such as floating shipping containers was cleared, and shoaling had not created navigational hazards. The USACE and NOAA share responsibility for conducting harbor surveys (USACE in federally maintained channels and NOAA in all other charted waterways), but the USACE New York District's waterfront facility, which contained scientific equipment that supported such work, was seriously damaged during the storm, and as a result NOAA performed a greater share of the survey work.

Local response organizations including Coast Guard and FDNY did not fully shut down during the storm but took numerous steps to reduce exposure while remaining on mission. While both agencies endeavored to perform essential response functions immediately after the storm, their work was disrupted by extensive flooding and damage that was especially problematic at a few key facilities. Coast Guard SECNY suspended all operations at its three small boat stations and its two Aids to Navigation (ANT) stations, evacuated personnel and families, and moved vessels to safe haven locations according to established hurricane evacuation plans so as to ensure the safety of people and equipment. As soon as it was safe to resume operations after the storm's passage, each SECNY unit began restoration activities to mitigate the damage their infrastructure received. While some units were able to return to full service within hours, others are at the time of this writing still operating at a degraded capability while they await repairs to waterfront facilities and shore side infrastructure. In particular, buildings, docks, and residential facilities at Coast Guard Station Sandy Hook (NJ), Station New York (Staten Island), and ANT New York (Bayonne, NJ), were severely damaged (Pierro pers. comm. 2013). Additionally, FDNY Marine Unit 9 ran on generator power for over four months after the storm and at the time of this writing is still running on temporary utility power (Schug pers. comm. 2013).

Most participants were still assessing losses and rebuilding costs when interviewed for this study. However, the PANYNJ reported in March that they were estimating $170 million in costs - $130 million of which was capital (Rooney pers. comm. 2013). SECNY reported in January that repair costs for the sector and sub-units were estimated at $76 million (U.S. Coast Guard SECNY 2013). Despite these extraordinary impacts, nearly all participants described this response and recovery effort as a success given storm size and surge extent. There was no loss of life within the Port community and no real damage to vessels, and most participants agreed that the Port was reopened, and basic operations restored, within a very short period of time given the extent of damage and disruption.

A. Lessons Learned: Successes

Many of the "lessons learned" identified in this study highlight the success of the response and recovery effort and the strengths that exist in the Port community; a select number are highlighted here. These strengths may be leveraged within the Port to enhance future planning for climate change, sea level rise, and other long-term port planning challenges. They may also be used by other port communities as areas for future planning and capacity building.

Coordination Within the Port. Most participants described their planning, response and recovery activities as a series of coordination efforts, both within their respective organizations and with external partners. Inter-organizational coordination was especially important with regard to the port closing and the post-storm recovery of the marine transportation system. Coordination activities included communication between SECNY and port partners about weather conditions and the closure of the port; coordination of multiple agencies to support post-storm harbor survey and cleanup activities; and coordination between the public and private sector to facilitate the resumption of port commerce. There was a resounding consensus among participants that port-wide coordination was not only efficient and effective, but evidence of the port community's strength and resilience.

The extent and efficiency of port-wide coordination may be due to a number of factors. Some described this coordination as stemming from the formal port governance mechanisms described above. Most important among these was the MTSRU, a relatively new port governance mechanism which had only been implemented in the Port twice before (Hurricane Earl in 2010 and Hurricane Irene in 2011) (Morrissey pers. comm. 2013). All participants who had participated in the MTSRU emphasized its effectiveness. A chief example of this was the post-storm work between SECNY, Sandy Hook Pilots, NOAA, and the USACE to survey the Port's waterways for navigational hazards. Participants described an arrangement between SECNY and the Pilots to use the pilots' vessels to conduct an initial post-storm waterways and aids to navigation assessment. Because the pilot vessels, unlike SECNY and NOAA vessels, had remained in the Harbor throughout the storm, the Pilots were able to get underway immediately after the passage of the storm with SECNY and NOAA officials aboard to conduct this initial assessment. This innovative public-private effort, involving two federal agencies and a private business, was coordinated through the MTSRU. Additionally, USACE and NOAA share responsibility for surveying waterways, but the USACE's facilities and surveying equipment were damaged during the storm, compromising their ability to conduct survey operations. As a result, NOAA expanded their survey operations and conducted roughly 68% of all waterways surveys (Pounds pers. comm. 2013).

Some participants also attributed effective coordination to the two port committees, the Harbor Ops committee and the AMSC, discussed above. All study participants represented organizations involved in at least one of the two committees, and many commented on how their longstanding involvement with these committees made it easier to know who to contact and how best to work together. For example, one participant stated that Harbor Ops "brought everyone together on a regular basis….People are used to working together for the betterment of the port" (McGovern pers. comm. 2013).

Relationships and Trust. Effective coordination was also facilitated by a network of relationships and trust between port partners, which may have been built through the committees as well as other prior experiences working together. One participant described the Port as "a pretty tight community – everybody knows everybody else and everybody's got everybody else on their speed dial" (Tavolaro pers. comm. 2013). Another noted that "we've been working all these issues for so many years, and developing that trust, so when something happens it just naturally flows. People…are used to working with each other and that trust is already built up" (McGovern pers. comm. 2013). Some described the resilience of the port in these terms, emphasizing that it is about people and difficult to measure. These

relationships are based largely in prior experience working together. SECNY representatives emphasized this, one noting that "You don't want to meet them in a crisis. You want to meet them when things are quiet, a day like today, and establish those relationships" (Fiumano pers. comm. 2013). Notably, many of these relationships span jurisdictional or public-private sector boundaries or the competition inherent in the private sector. One participant recounted, "in the height of the fuel crisis, Coast Guard and NOAA were having difficulty finding gasoline to fuel NOAA harbor survey vessels; a MTSRU participant who is a representative of one cargo terminal, a private business, overheard this conversation and offered gasoline to fuel the vessels at no charge" (Sturgis pers. comm. 2013).

Prior Experience. Effective coordination, response and recovery was facilitated by the prior experiences of participants, and the port community in general, in dealing with previous storms and other disasters. Chief among these was the terrorist attacks of September 11, 2001 (9/11). Most participants referenced the port community's experiences during 9/11, and in some cases, individuals recounted detailed stories of how the maritime community coordinated and improvised during the 9/11 response. One noted that the relationships described above are founded in that event: "You saw this in 9/11 and other events…people who would normally compete when it comes to the port, they would work together" McGovern pers. comm. 2013). Another participant even described Sandy in those terms: "in the maritime environment, this was our 9/11" (Rooney pers. comm. 2013).

Others described how the Sandy response and recovery was informed by the Port's experience during Hurricane Irene in 2011. Hurricane Irene had been predicted to have extreme impacts on the greater New York City metropolitan region, and was the first time that SECNY had fully implemented the MTSRU as an initiative involving both the Coast Guard and port partners (Morrissey pers. comm. 2013). Many described Hurricane Irene as a dry run for the Port community; one SECNY representative commented that "we were really able to practice in a real-world situation without there being catastrophic damage, and we were really grateful for that. It got the port community ready" (Morrissey pers. comm. 2013). To be clear, experience with prior disasters, especially tragedies like 9/11, is not in itself a success or a recommendation. However, it is evident that these prior experiences were foundational to how the Port community dealt with Sandy, and future research should investigate how the knowledge and expertise gained through these experiences can be transferred elsewhere so that others can benefit from the collective knowledge held in the Port of NY and NJ. Additionally, as disaster response and recovery exercises and simulations are an established practice, future research should investigate how such exercises might be enhanced to better replicate some of the complex response and recovery challenges port partners experienced in these real-world disasters.

Beyond Planning: Expertise and Improvisation. Another key to success was port partners' ability to improvise before, during, and after the storm, drawing upon the relationships described above, as well as prior experiences and professional expertise. This was necessary due to the extraordinary size of the storm and associated surge, which flooded areas and caused damage that for some was unanticipated. There were countless examples of improvisation during Sandy; one is recovery and continuity of operations at two severely damaged Coast Guard stations, Sandy Hook and New York. At Sandy Hook, active duty Coast Guardsmen who had evacuated prior to the storm returned immediately afterward, with a small boat they had taken with them on a trailer to a hotel, and used it and other equipment to tow docks back into place and tie them off to jetties, and began standing duty again, just hours after the storm passed (Pierro pers. comm. 2013). In addition, Station New York was so severely damaged that it could not resume full operations on site right away, and so firemen at FDNY Marine Unit 9, located nearby on Staten Island, invited Station New York's crew to live and work at their firehouse. As a result, the two units, representing one federal agency and one city agency, cohabitated for nearly three

months. Another example is SECNY's work to reopen port facilities. One participant described working to develop alternative compliance measures for security requirements, and working with staff in the field to evaluate conditions: "I said, 'if a proposal seems right while you are visiting the facilities, go ahead and approve it, and we'll work through documenting their plan amendments later.' There was a lot of risk-based operational decision-making physically in the field" (Sturgis pers. comm. 2013).

The Value of Maritime Assets. One last success was the way in which maritime resources helped support the recovery of the broader region. There are numerous examples of this. The importance of NOAA and USACE's emergency response survey and marine debris removal capabilities, which facilitated the rapid reopening of the Port, was discussed above. In another example, New York City and FEMA together implemented two emergency ferry services in November to supplement mass transportation disruptions resulting from the storm. One ferry service ran from Manhattan to Staten Island for approximately two months after the storm. A second service was set up between Manhattan and the Rockaways in outer Queens; as of May 2013 this service is expected to run at least through late summer, a total of nine months, because of ongoing transportation disruptions (DeSimone pers. comm. 2013).

Another important example is the service that MARAD provided during storm recovery. MARAD sent three of its ships to the Port, including two maritime academy training ships and one ship from its Ready Reserve Force, solely to provide dockside housing for FEMA and other relief workers. This reduced the burden on hotels in the region and reduced the cost of disaster response and recovery. Together, these three ships had a berthing capacity of over 1500, and stayed in the Port for over six weeks after the storm; the three ships provided over 38,000 berth nights and 74,500 meals, resulting in a cost avoidance of over $3.7 million (MARAD 2013).While this work happened outside of the context of port response and recovery discussed in this report, it is an example of the ways in which maritime resources can help facilitate efficient and cost-effective storm response and recovery. What is notable about this arrangement is that this was not a pre-arranged plan. Rather, it came about after the storm, in part as a result of MARAD's outreach efforts earlier that year to educate agencies and organizations in the New York region on how maritime resources can support disaster response (Jackson pers. comm. 2013). As bringing in outside resources such as ships and personnel can require extensive coordination and logistical support, future research should examine how to better integrate such resources into response and recovery planning from the outset so as to maximize their benefit.

B. Lessons Learned: Challenges

Other "lessons learned" identified in this study highlight challenges that the Port community may choose to prioritize for future planning and capacity building. All lessons learned here were explicitly identified by at least some participants, and many are outside of the direct control of the port partners. They are not listed in any particular order, and all would require further research to guide future action.

Storm Surge. Nearly all participants described Sandy as a "surge" event, and extensive flooding damage to waterfront infrastructure – in areas that participants had never known to be flooded or at risk of flooding – was ubiquitous. Storm surge had a significant impact on commercial port operations, due in part to the concentration of infrastructure and resources in low waterfront areas adjacent to commercial berths. Flooding affected these operations in countless ways, including by damaging electrical equipment, such as electric motors powering cranes used for offloading cargo; damaging equipment such as truck chassis used for transporting cargo beyond the Port; damaging docks and piers that support responder, passenger ferry, and other vital operations; and damaging scientific equipment used for conducting harbor surveys. This suggests a need for storm surge planning. As several

participants pointed out, hurricane plans are typically designed to address wind, not surge, events, and no participant indicated having seen flooding like this before in the Port. A PANYNJ representative acknowledged that storm surge had not been part of their hurricane plan; this was in part because the "history" of flooding was simply not there, and because the floodplain maps they had been using suggested a risk of minimal flooding in areas that were severely damaged (Rooney pers. comm. 2013).

Power. Many participants identified the widespread, prolonged power outages following the storm as among the worst of the problems resulting from Sandy. Loss of power, and what many participants described as challenges communicating with electrical companies, impacted the Port in numerous ways. Loss of power meant a loss of communications – landlines, cell phone towers, and Internet – such that many vital recovery operations were conducted using personal devices. One MTSRU participant quipped, "The whole thing revolved around an iPhone. Let's reopen the Port using Anne's iPhone" (Schoenlank pers. comm. 2013). Loss of power also meant an inability for terminals to handle product. In the case of PANYNJ facilities, loss of power also resulted in safety and security concerns. Security fences – in some cases surrounding lots full of recently imported cars with the keys inside them – created the risk of theft, and the absence of traffic lights and firefighting equipment created potentially dangerous conditions for staff. Some also emphasized how even after the waterways had been reopened for commerce, oil terminals were still unable to handle and distribute petroleum products because they had no power. This suggests, among other things, a need for improved coordination between the Port sector and power companies. The Port community relies very heavily on power suppliers, and future storm planning must include this vital sector. Whereas Con Edison, New York City's electricity supplier, was included in the MTSRU, it may be that further involvement of this company, and other companies supplying electricity to the New Jersey side of the Port, are merited.

Fuel. The "no power" problem described above was closely related to the "no fuel" problem. Fuel shortages in the immediate aftermath of the storm were widely publicized, with media highlighting lines at gas stations and the implementation of rationing policies. Petroleum products' movement through the Port was delayed not only because of the Port's temporary closure while waterways were being surveyed, but because oil terminals did not have power and therefore could not move product, brought in by tankers, within and beyond their facilities. This problem had a ripple effect through the region and the Port community. Critical response work such as harbor surveys was temporarily inhibited due to the fuel shortage, and some Port personnel couldn't get to work. In addition, some participants reported that this became not only a logistical but a public relations problem when politicians and other leaders began criticizing the Coast Guard for ostensibly holding up the flow of fuel and other cargo. Many port partners were able to improvise to deal with this problem; for example, the PANYNJ brought in a fuel truck to provide gasoline for essential staff members (Rooney pers. comm. 2013). There is no one simple way to address this issue. Some organizations may decide to maintain reserve fuel tanks with their response equipment; for example, NOAA indicated that this might be recommended (Pounds pers. comm. 2013). Perhaps more importantly, however, oil terminals and other facilities may need to build in alternative power sources, or improve the resiliency of their infrastructure. As no representatives of oil terminals were interviewed for this study, this will be a key area for future investigation.

Waterfront Buildings and Structures. While effective preparation resulted in no loss of life and nearly no damage to vessels, the storm surge resulted in severe damage to some waterfront buildings and infrastructure that support vital waterfront services. These included the USACE NY District's waterfront facility, which supports their harbor survey and marine debris removal operations; SECNY small boat stations Sandy Hook and New York, which support search and rescue, marine safety, and law enforcement missions; and the Coast Guard Aids to Navigation station at Bayonne, which supports

navigation safety. These also include the Sandy Hook Pilots' building on the Staten Island waterfront. Damage included extensive flooding inside buildings that destroyed building structure and materials, and damage to adjacent piers and floating docks. Some buildings were rendered virtually uninhabitable. A Sandy Hook Pilot representative recounted having about 4-5 feet of standing water in their building, with waves on top of that, and described anecdotes in which a steel door and frame were completely torn out and wood decking on their pier was rolling up and down with the water "like you see on a piano" (McGovern pers. comm. 2013). While all of these organizations continued to perform their missions during and immediately after the storm, due to their ability to coordinate and innovate, they were all nonetheless faced with extreme and costly damage to their facilities.

In the densely developed metropolitan area surrounding the Port, there are few options for relocating waterfront facilities to reduce vulnerability to storms; one participant commented, "You can't say we're gonna move everything…there's no alternative, just because of where we're located" (DeSimone pers. comm. 2013). Instead, waterfront buildings and infrastructure that support water-dependent services will likely need to be redesigned to accommodate future storm events. For most participants, it was too early in the recovery process for them to have clear visions of how they will redesign or rebuild. However, participants introduced initial ideas about either elevating or redesigning their structures. The Sandy Hook Pilots stated unequivocally that they intend to fully elevate the entire building, and referenced examples from Gulf Coast pilot houses to illustrate their point. Other participants indicated that they might consider elevating parts of their building, or consider design features and materials that would allow their building to be effectively flood proof. For example, one participant suggested that "wood and sheetrock need to be removed from the building and you need to go in with glass blocks, stainless steel, and appropriate venting. And just assume that the space is going to flood, and design it so that it can flood. And then you can just hose it out" (DeSimone pers. comm. 2013).

Waterfront Electrical Infrastructure. In addition to building and structural damage, much waterfront electrical infrastructure was wiped out because of saltwater intrusion or other types of damage. This meant that a large amount of infrastructure on the first floors and in basements of buildings was completely destroyed, and in some cases generators intended to provide alternate power also did not work. A notable example of this was the failure of electrical engines used to power large cargo cranes. Participants described how these cranes once ran on diesel engines, but were switched to electrical power as part of the Port's efforts to improve air quality (see e.g. PANYNJ 2009). Whereas diesel engines, commonly used in the marine environment, may have survived saltwater intrusion, the electrical engines did not. This problem suggests that much waterfront electrical infrastructure should be elevated and perhaps redesigned given the likelihood of future saltwater flooding. Participants described many ideas for elevating, 'floodproofing,' or fundamentally rethinking electrical infrastructure; for example one described installing "almost like a ship's watertight door" to a space containing many of his facility's electrical panels (DeSimone pers. comm. 2013).

Coordination: Outside of the Port. While inter-organizational coordination was very strong within the Port community, study results suggest that coordination with entities outside of the Port community – but that the Port relies upon - may be less robust. A chief example of this is the Port's reliance on power; many participants emphasized that improved communications with the electric companies was vital for future response and recovery efforts. One participant described this within a broader context of "interdependencies," commenting: "The Coast Guard coordinates really well…. they're sharing lots of information in the universe of the Port and keep all the major Port players prepared. [But….] There needs to be further coordination between sectors. The port is a sector, let's say. But then you have the water and wastewater sector, the power sector…We need to be planning more this way" (Picciano pers.

comm. 2013). As this study largely focused within the port sector, future research may specifically investigate communication and coordination efforts between the port and other sectors.

Data and Information. Many participants agreed that the sharing of information is nearly always an area for improvement. While many of the information needs are not surprising – timely information on weather conditions, port closures, and areas of the harbor surveyed – two items merit specific attention. One participant indicated the need for improved floodplain maps as well an improved understanding of the Port's vulnerability to climate change and sea level rise (Rooney pers. comm. 2013). Another participant identified a similar need, noting that improving the availability of site-specific data on projected storm surge would help both Port facilities and adjacent businesses prepare for surge events (Picciano pers. comm. 2013). This speaks both to the importance of sharing information between organizations, and to the ways in which the scientific community can support the maritime community.

"Messaging" the Port. A somewhat unexpected issue was the problem many participants had communicating about port recovery with politicians, public officials and other senior leaders in government. In the midst of response and recovery activities, SECNY representatives were fielding inquiries about why the port was closed and the distribution of petroleum products delayed. Several participants even mentioned incidents in which SECNY's closure of the port was blamed for causing the regional fuel shortage. Because of this, Coast Guard officials who were overseeing the port recovery work were simultaneously engaged in "messaging" – conducting their own public relations by explaining why harbor surveys must be conducted before reopening the Port and that even once the Port was fully reopened, oil terminals and refineries still must have power and functioning infrastructure in order to offload and distribute fuel. As such, port partners were effectively educating the broader community on the fly about how the Port, critical infrastructure, and the supply chain works (Sturgis pers. comm. 2013). While port partners seem to have dealt with this challenge extremely well – improvising based on prior experience and professional expertise – it seems clear that political leaders and the broader public must be educated about the Port and the MTS recovery process. SECNY and port partners have already taken a key step in this direction by holding three meetings in March and April 2013 to share information with New York and New Jersey political leaders in this regard (Morrissey pers. comm. 2013).

Personnel Management. A final challenge was that of personnel management. One problem was transportation: the region's mass transportation infrastructure and roadways were all compromised, and then fuel shortages became evident, so personnel who had evacuated Port facilities during the storm had trouble getting back to work to support recovery efforts. As a PANYNJ official noted, "It's difficult to send them out and bring them back" (Larrabee pers. comm. 2013). Further, many personnel had experienced storm disruption in their personal lives; many had damage, no power, and in some cases total losses, at their homes, and were required to temporarily relocate their families. SECNY personnel and families were required to evacuate housing at sites like Sandy Hook. Another problem was safety and security at port facilities. A PANYNJ participant noted how power outages meant that there were no traffic lights and life support equipment (i.e. firefighting), rendering conditions potentially unsafe, such that facilities were open only to essential staff, during daylight hours, for days following the storm (Rooney pers. comm. 2013). These problems suggest that personnel management may need to be more explicitly and comprehensively integrated into the Port's future storm planning work.

C. Outstanding Questions

This study identified numerous outstanding or big picture questions – many of which were explicitly raised by participants – which merit future research. Investigation of these questions will help Port

practitioners make decisions for both the short and long term, and will help other port communities prepare their maritime responders, operators, facilities and infrastructure for future storm events.

How can we use Sandy as a "window of opportunity" and actually act on the lessons learned? Some participants noted that Sandy may mark a significant change or shift in thinking about and planning for storm events. One commented, "On a national level people are thinking about how we might change things based on Sandy" (Tavolaro pers. comm. 2013). Another remarked that Sandy "made believers out of some cynics who said this climate change stuff is a bunch of nonsense…it's made believers out of all of us" (Larrabee pers. comm. 2013). However many of the same participants expressed concern that it might not result in real change. Some commented that people don't always act on lessons learned, and that in a few months everyone will have moved on to the next problem. "The real question is not so much what do we do, but how do we find the will to fix some of these things?" commented on participant (Larrabee pers. comm. 2013). How can Sandy can be seized as a "window of opportunity" to improve future storm planning and the resiliency of port operations and infrastructure to the long-term threats of climate change and sea level rise?

What mitigation ideas are practical, cost effective, and feasible? While many ideas, proposals, and reports have been introduced following the storm, participants emphasized the importance of finding solutions that are practical, feasible, and affordable. In particular, many spoke with skepticism about the highly-publicized proposal to install a storm surge barrier across the mouth of the harbor under the Verrazano Narrows Bridge (see e.g. Navarro 2012). One participant commented that her organization really needed "feasibility studies" to help them make decisions about "reasonable mitigation measures" (Rooney pers. comm. 2013). What mitigation measures are reasonable and appropriate investments for Port operators given the risk of future storm events?

How will we fund improvements, both in the short term and the long term? Most participants indicated in some way that response and recovery activities, as well as mitigation measures in preparation for future events, are expensive, and expressed concern about funding these improvements. As noted above, the PANYNJ currently estimates the cost of the storm at $170 million. How much will it cost the entire Port community to recover from Sandy, and who will pay? How can the political will be generated to fund mitigation measures that could limit the possibility of incurring further costs in future events?

How can the Port community's social capital be replicated elsewhere? The powerful relationships between port partners that are discussed above are a form of social capital - relationships between individuals, characterized by respect, trust, credibility, reciprocity, and networks. These relationships have value because they provide access to information and resources and can be relied upon in times of crisis. Social capital has been identified as a key to achieving resiliency to coastal disasters and climate change (e.g. Adger 2003, 2005). This research suggests there is a great deal of social capital in the Port of NY and NJ. While this study has not compared this port with other ports or other storm events, it is likely that some other ports could benefit from augmenting their social capital. How can this social capital be replicated elsewhere? Is it reliant on a long history of working together or prior experiences responding to extraordinary disasters like 9/11? Or can it be cultivated in places that do not have this history?

What does a "resilient port" look like? The term "resiliency" was used by nearly every participant, despite the fact that this term wasn't initially introduced by the researcher. Participants offered widely varying conceptualizations of resilience. Some described it simply in economic terms, emphasizing the resiliency of the supply chain and maritime commerce. Others described it in physical terms, describing it as the ability of buildings, transportation and electrical systems, and other infrastructure to withstand

or bounce back quickly from a disaster. Still others described it in entirely social terms, emphasizing the interconnectedness between sectors, or the relationships and trust that made it possible for study participants and other port partners to respond to and recover from this event. It may be that a resilient port is all of those things. However, given the widespread use of this language, including by government agencies spearheading resiliency initiatives, achieving a common, practical vision of port resiliency – one that can easily be applied to the real-world context of the Port – may enhance the existing resiliency initiatives being pursued by port operators, planners, managers and policymakers.

How can the Port of NY and NJ move forward in long-range climate change adaptation planning?
While it is very difficult to attribute any individual storm event, including Hurricane Sandy, to climate change, this event has nonetheless illustrated that the odds of such extreme storms are increasing (see e.g. Greene et al. 2013), highlighting the vulnerability of the greater New York City metropolitan region in general and the Port in particular to extreme storm surges. This study has illustrated that the Port community has a great deal of strengths and as such has been very successful at responding to and recovering from extreme disasters, whether it be 9/11 or Hurricane Sandy. However the extent to which these strengths are being leveraged to respond to the long-term threats of climate change and sea level rise is not at all clear. How can the Port community's assets – its effective port governance mechanisms, network of experienced professionals, and wealth of social capital - be leveraged to facilitate long-range climate change adaptation planning? And who will spearhead such planning such that it encompasses the diversity of responders, operators, facilities and users sampled in this study?

VI. Conclusion

This study has identified a series of lessons learned, based on the Port of NY and NJ's experience with Hurricane Sandy, that can be used to inform planning for future storms and for the long-term threats of climate change and sea level rise. These lessons learned include strengths to be capitalized upon and areas for improvement in future planning. Strengths and successes include coordination within the Port community; relationships and trust; prior experiences with disaster response; professional expertise and the ability to improvise; and the multiple ways in which maritime assets can support storm response and recovery. Challenges and areas for improvement include storm surge planning; prolonged power outages and fuel shortages; impacts to waterfront buildings, structures, and electrical infrastructure; coordination beyond the Port community; sharing data and information; "messaging the Port"; and personnel management. In addition, this study has identified a series of big picture questions: Will lessons learned truly be learned? What mitigation measures are practical and appropriate, and how can the political will be developed to support funding both recovery and mitigation? How can the social capital of the port be leveraged within the port and replicated elsewhere? What does a "resilient port" look like? And how can the strengths of the Port of NY and NJ community be leveraged most effectively in support of long-range port resiliency and climate change adaptation planning?

All of these lessons learned and big picture questions will require further research. The information presented here is based on key informant interviews with a small sample of Port professionals, primarily representing the public sector; additional data must be collected from other members of the Port community, from other sectors (e.g. energy), and from other areas of expertise to provide insight into how this and other port communities can leverage strengths to address the challenges discussed here, and to prepare for the long-term threats of climate change and sea level rise. Additionally, further scholarly research must be conducted to contextualize this discussion within the broader context of disaster planning, hazard mitigation, port resiliency and climate change adaptation. The researcher's planned next steps to address these needs include launching a second round of data collection, which

will include interviewing a wider range of port partners and stakeholders about long-range planning; and developing at least one peer-reviewed journal article that discusses the data and findings presented here within the broader context of the scholarly literature on port resiliency.

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APPENDIX I. ADDITIONAL MAPS SHOWING PORT FACILITIES

Figure 2. Locations of Select Port Facilities (Image: Google Earth)

Figure 3. Detailed View: Locations of Select Port Facilities (Image: Google Earth)

APPENDIX II. INTERVIEW PROTOCOL

Assessing the Impacts of Hurricane Sandy on the Port of New York and New Jersey's Maritime Responders and Response Infrastructure

BEFORE BEGINNING INTERVIEW:

- Review study goals, objectives, and confidentiality provisions and ask participant if he/she has any questions before proceeding.
- Ensure informed consent form is signed.
- Ask permission to record interview.

INTERVIEW QUESTIONS:

1. What was your role/area of responsibility related to Hurricane Sandy?
2. What pre-storm plans or systems were in place [at your facility/organization] prior to the storm?
3. Take me through the chronology of events of what you were doing and what you experienced before, during, and after the storm. What happened?
4. Who did you coordinate with before, during and after the storm event? To what extent/through what mechanism?
5. Did you need to improvise from the plans and preparations you had made? In what way?
6. What are some lessons learned that may inform future planning – for your facility and for the port?
7. Lots of people are talking about "resilience" or "port resilience." What does this mean to you?
8. Are there any other documents I should review or people I should speak to?

APPENDIX III. INFORMED CONSENT LETTER APPROVED BY USCG INSTITUTIONAL REVIEW BOARD.

CONSENT TO PARTICIPATE IN RESEARCH

"Assessing the Impacts of Hurricane Sandy on New York City's Maritime First Responders and Response Infrastructure"

You are asked to participate in a research study conducted in New York Harbor by Dr. Tiffany C. Smythe of the U.S. Coast Guard Academy. Your participation in this study is voluntary. You should read the information below and ask questions about anything you do not understand before deciding whether or not to participate.

PURPOSE OF THE STUDY
This study is intended as a preliminary assessment of Hurricane Sandy's impacts on New York City maritime first responders and other maritime operators, with the goal of identifying "lessons learned" that can inform planning for future coastal storm events.

PROCEDURES
If you volunteer to participate in this study, you will be asked to participate in one in-person interview at your maritime facility. During the interview, you will be asked about the impacts of Hurricane Sandy on your facility, how you prepared for the storm beforehand, and what you would do differently in the future. The interview may last between 30 minutes and 1 hour. *If you consent*, the interview will be recorded so that your input is accurately noted. However, your information will remain confidential and you will not be directly quoted in final publications or presentations unless you specifically give your permission for the researcher to quote a specific phrase or sentence.

POTENTIAL RISKS AND DISCOMFORTS
There are no potential risks or discomforts associated with this study.

RISKS TO DISCLOSURE OF SENSITIVE INFORMATION
Discussion of natural disaster preparedness and response could include sensitive security-related information. *You are not being asked to disclose sensitive information*. If information you might provide in the interview may be sensitive, please make sure that your supervisors have authorized you to share this information with the researcher.

ANTICIPATED BENEFITS TO SUBJECTS
This study may result in benefits for you, your colleagues, and the broader community of maritime scholars and professionals. "Lessons learned" that are synthesized from this study will be shared with you and other study participants as well as with scholars, with the goal of highlighting the importance of maritime first responders in pre-disaster planning and improving planning for future storm events.

CONFIDENTIALITY
When the results of the research are published or discussed in presentations, no information will be included that would reveal your identity. The Principal Investigator is the only individual who will have access to your interview recording and transcript. Interview transcripts will be coded with a non-personally identifiable code, and all names will be redacted from transcripts. Final results, which will be

disseminated in scholarly publications and presentations, will be synthesized so that no one individual's input is identifiable. You will not be directly quoted unless you specifically give your permission for the researcher to quote a specific phrase or sentence.

PARTICIPATION AND WITHDRAWAL
Your participation in this research is voluntary. If you choose not to participate, that will not affect your relationship with the U.S. Coast Guard Academy. If you decide to participate, you are free to withdraw your consent and discontinue participation at any time without prejudice.

IDENTIFICATION OF INVESTIGATORS
If you have any questions about the research, please feel free to contact Dr. Tiffany C. Smythe, Principal Investigator, at 860.701.6625; Tiffany.C.Smythe@uscga.edu; or at the Center for Maritime Policy & Strategy, U.S. Coast Guard Academy, 15 Mohegan Avenue, New London CT 06320.

RIGHTS OF RESEARCH SUBJECTS
You may withdraw your consent at any time and discontinue participation without penalty. You are not waiving any legal claims, rights or remedies because of your participation in this research study. If you have questions regarding your rights as a research subject, you may contact the Principal Researcher listed above.

For any questions on research participants' protections, please contact the CG-11 Institutional Review Board at Coast Guard Headquarters by writing to Dr. Carlos Comperatore at Carlos.A.Comperatore@uscg.mil.

SIGNATURE OF RESEARCH SUBJECT
I have read the information provided above. I have been given an opportunity to ask questions and all of my questions have been answered to my satisfaction. I have been given a copy of this form.

_____
Name of Subject

_____ _____
Signature of Subject Date

SIGNATURE OF WITNESS
My signature as witness certifies that the subject signed this consent form in my presence as his/her voluntary act and deed.

_____
Name of Witness

_____ _____
Signature of Witness Date