FISHER MARITIME
Consulting Group
Consulting Naval Architects and Marine Engineers, Project Managers

- Final Report -

In the Matter of the October 1, 2015 Loss of the *S.S. EL FARO*

August 31, 2017

This report addresses the sinking of the *S.S. EL FARO* (the "Vessel") on October 1, 2015 at approximately 7:39 am Eastern Daylight Time ("EDT") during its encounter with hurricane *JOAQUIN* at a location approximately 40 nautical miles northeast of Acklins and Crooked Islands in the Bahamas. At the time, the Vessel was en route to San Juan, Puerto Rico with a cargo of containers and vehicles. The Vessel's 27-person crew, as well as one supernumerary and five "riding gang" workers, all perished in the incident. This report includes identification of documents and other information that have been reviewed and analyzed to date in connection with the matter. It also presents findings and conclusions based upon such review and analysis. Fisher Maritime expressly reserves the right to supplement and/or amend the information presented herein should additional relevant material be produced.

Information reviewed

[1] Information used in the preparation of this report includes the author's inspection of a sister ship[1] to the Vessel (*S.S. EL YUNQUE*) in Seattle, WA on October 20, 2016. Additional information reviewed to date in the preparation of this report includes the following:

- files downloaded from the National Transportation Safety Board ("NTSB") "Docket Management System" (at dms.ntsb.gov – NTSB Accident ID 16MM001) including, but not limited to, "*Voyage Data Recorder – Audio Transcript Group Chairman's Factual Report*," "*Survival-Group Chairman's Factual Report*," "*El Faro Engineering Group Factual Report*," "*Electronic Data-Group Chairman's Factual Report,*" "*Meteorology Group Factual Report*" and "*Nautical Group Chairman's Factual Report*[2]";
- Exhibits 277, 285 and 288 prepared by the US Coast Guard ("USCG") Marine Board of Investigation ("MBI");
- General Arrangement plans for the Vessel, Sheets 1 through 4 of 4 prepared by Herbert Engineering Corp. and dated April 24, 2006;
- USCG regulations for Cargo and Miscellaneous Vessels set forth in Title 46 of the Code of Federal Regulations ("46 CFR") at Subchapter I;
- the Vessel's USCG-issued Certificate of Inspection;
- the Vessel's American Bureau of Shipping ("ABS") confirmation of Class status;
- the Vessel's ABS 5 and 10 year survey records and October 9, 2015 status report;

[1] The term "*sister ship*" refers to a vessel of the same class and/or design as another ship. Sister vessels share virtually identical hull and superstructure layouts, as well as comparable equipage.

[2] As well as TOTE's written comments regarding this report.

- the Vessel's ABS Safety Management Certificate;
- the Vessel's ABS Safety Equipment Record and SOLAS Safety Equipment Certificate;
- nautical chart published by the National Oceanic and Atmospheric Administration ("NOAA") – number 11013 – *STRAITS OF FLORIDA and Approaches*, 48th Edition, February 2012;
- nautical chart published by the National Geospatial-Intelligence Agency ("NGA") – number 27005 – North Atlantic Ocean-Caribbean Sea *KEY WEST TO SAN JUAN*, 4th Edition, June 1996;
- various bulletins, storm tracks and voice broadcast transcripts containing information regarding hurricane *JOAQUIN* disseminated by the NOAA National Weather Service ("NWS") and National Hurricane Center("NHC");
- information regarding hurricane *JOAQUIN* disseminated by the Bon Voyage System ("BVS") of the Applied Weather Technology/StormGeo organization;[3]
- Vessel track data, including spreadsheet of positions derived from multiple on-board systems such as the Automated Identification System ("AIS");
- copies of certain emails between the Vessel's captain and other TOTE personnel; and
- transcript of testimony by R. Brown and J. Hale at USCG hearings of May 18, 2016.

Author's expert credentials

[2] The contents of this report are also based upon the author's professional education, training and experience, described in the curriculum vitae attached as Appendix A to this report. All findings, analyses, opinions, etc. contained in this report are expressed as professional understandings arising from such education, training and experience and are not presented as any manner of legal conclusions. The author's background includes considerable service as a ship master, tugboat captain and harbor pilot, and also as a senior-level executive of vessel operating companies. Accordingly, he is recognized by federal and state courts throughout the United States as an expert in marine transportation operations upon ocean, coastal and inland waters. In particular, he has had served aboard various types of vessels along coastal and oceangoing routes in North Atlantic Ocean waters in positions from 3rd Officer to Master and has had multiple first-hand experiences with the presence of hurricanes in way of vessel tracks at sea. He has also served as a senior-level operations executive in companies operating various types of vessels in North Atlantic Ocean waters.

[3] BVS is a desktop application that provides subscribers such as the Vessel with weather-related information through email or broadband interfaces.

Arrangement of the Vessel

[3] Depicted by the illustration[4] below, the Vessel was originally built in 1975 as a *roll on-roll off* ("RO/RO") ship, which is a cargo ship designed to transport "wheeled" units such as automobiles, trucks, trailers, etc. Steel ramp structures deployed between the Vessel's main deck and a dock surface enable vehicles to be driven aboard on their own wheels. The Vessel underwent refurbishments in 1993 and 2006; the first entailing a lengthening of the Vessel by 90 feet and the second involving its conversion to carry containers as well as RO/RO units.

[4] The "*S.S.*" in the Vessel's name is short for "*Steam Ship*" and indicates that it is powered by steam-driven machinery. In simplest terms, this means that the Vessel is fitted with boilers, which produce high-pressure steam that drives steam turbines. These turbines are connected through a set of reduction gears to a single propeller shaft and 5-bladed propeller. Additionally, the Vessel was "classed" by the ABS, which is one of a number of recognized maritime regulatory agencies referred to as "classification societies."

[5] A classification society is a non-governmental organization that establishes and maintains published rules for the construction and operation of ships. Examples of classification societies include ABS, Lloyd's Register, DNVGL and ClassNK. Federal or national government agencies having jurisdiction over their respective maritime industries (such as the USCG), as well as vessel insurance underwriters worldwide, rely on certification of compliance with such classification society rules as proof that a given vessel

[4] "El Faro." *Maritime-Connector*, n.d., http://maritime-connector.com/images/el-faro-3-ships-23599.jpg. Accessed 16 February 2017.

has been properly constructed and is seaworthy. In this case, the Vessel was originally constructed in accordance with the ABS "*Rules for Building and Classing Steel Vessels*." It was surveyed during and upon completion of its construction by ABS inspectors, and was regularly re-surveyed during its operational life. The Vessel was continuously certified by ABS as being fully compliant with all applicable construction and operation rules and, per ABS and USCG records, its post-conversion principal characteristics were as follows:

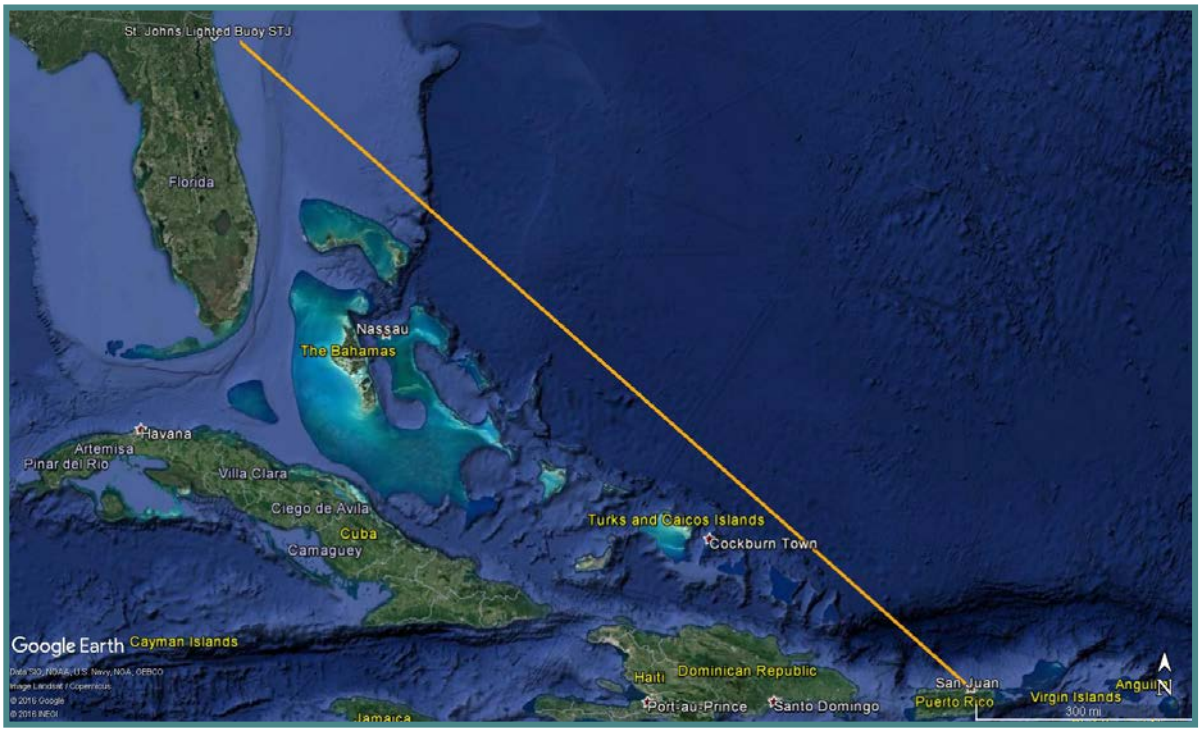
- Length: 790 feet
- Beam: 105 feet
- Draft: 30 feet
- Gross tonnage: 31,515 tons
- Propulsion power: 30,000 shaft horsepower
- Service Speed: 20 knots
- Crew complement: 27

[6] Additionally, the Vessel was issued and maintained a USCG "*Certificate of Inspection*," meaning that it was regularly inspected and certified compliant with all statutory requirements for a cargo ships of its type and size on ocean routes,[5] further confirming its fitness for such service.

Voyage Plan

[7] The Vessel was engaged in regularly scheduled service between the ports of Jacksonville, FL and San Juan, PR. On a typical outbound voyage, the Vessel would depart Jacksonville and be piloted out through the St. John's River into the Atlantic Ocean. Once clear of the last entrance channel buoy (Lighted Buoy "STJ"), the Vessel would proceed in a basically southeasterly direction along a course line to the San Juan harbor entrance channel approximately as shown in the following illustration.

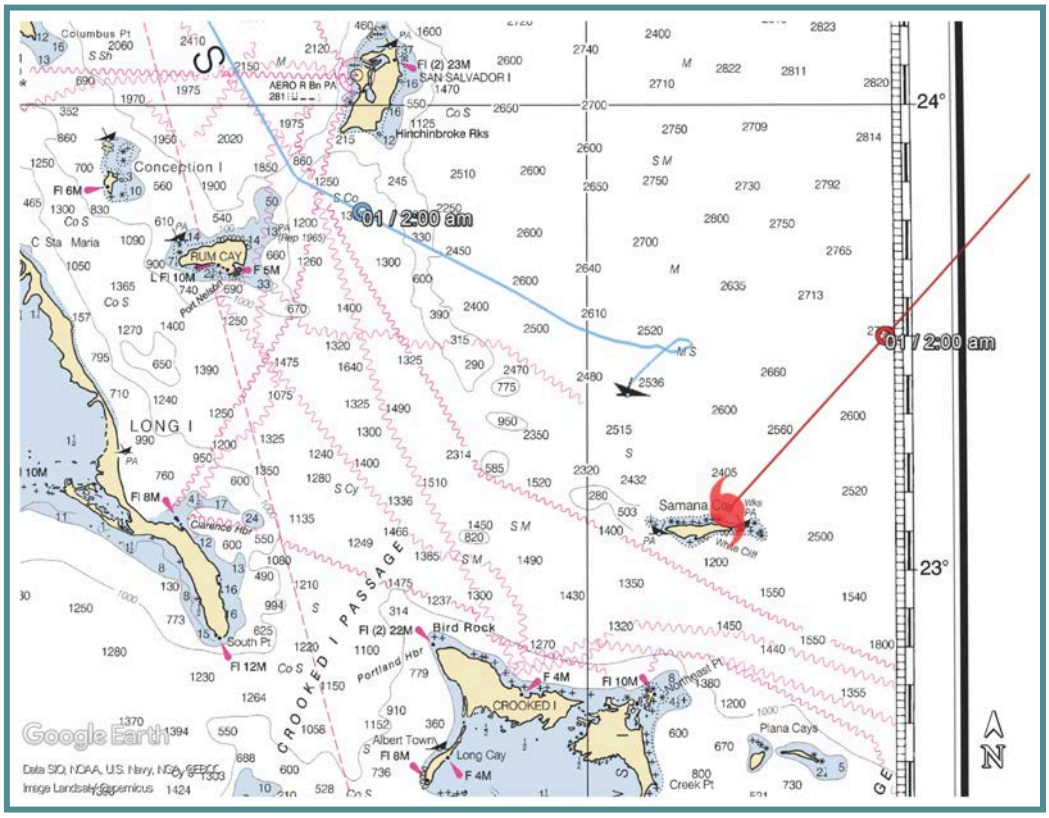
[5] It is noted that the Vessel was enrolled and participated in the USCG's Alternate Compliance Program ("ACP"). Per the USCG web site, "*In this voluntary program, Classification Society Rules, International Conventions, and an approved U.S. Supplement provide an alternative that is equivalent to the CFR. Compliance with this equivalent alternative standard is administered through survey and inspection conducted by authorized classification society surveyors. A Certificate of Inspection (COI) is issued by the Coast Guard to a vessel enrolled in the ACP based upon the classification society reports*." ("Alternate Compliance Program ACP." *US Coast Guard*, 11 January 2017, https://www.uscg.mil/hq/cgcvc/cvc1/aip/acp/acp.asp. Accessed 15 March 2017.)



[8] In connection with the voyage at issue, it was known that a tropical depression had formed in the Atlantic Ocean to the northeast of the customary Vessel course line, and that the potential existed for this system to strengthen into a hurricane (this depression did later become hurricane "*JOAQUIN*"). As explained further below, the presence of this weather system led the Vessel's captain to implement multiple departures from the usual course line, in the interest of maintaining a safe distance from the developing storm system.

Arrangement of the loss site

[9] The illustration on the following page shows the respective track lines of both the Vessel and *JOAQUIN* from shortly before midnight on September 30, 2015 up to the time of the accident at approximately 7:39 am EDT on October 1, 2015, at which time the two were separated by a distance of approximately 20 nautical miles. The Vessel's track was plotted onto the NOAA navigational chart for the area using the actual latitude/longitude coordinates retrieved from its Voyage Data Recorder ("VDR"), which "black-box" unit was recovered from the sunken Vessel by the NTSB several months after the accident. The path of hurricane *JOAQUIN* was plotted from the best track of the storm's center as reported after the accident by the NHC. As explained herein, noticeable differences existed between the storm's actual position (as later determined by the NHC) and forecast position information transmitted by NHC and received aboard the Vessel. Nonetheless, environmental conditions at the accident site at 7:39 am EDT on October 1, 2015 (as determined by the NTSB Meteorological Group) entailed hurricane-force winds and accompanying 27+ foot waves of a Category 3 (sustained winds > 110 mph) cyclonic system.



The roles and components of available electronic data

[10] As explained below, the Vessel was equipped with a "*Global Maritime Distress and Safety System*" ("GMDSS") in full compliance with applicable regulations. The GMDSS concept was developed by member nations of the International Maritime Organization ("IMO") and is the product of amendments adopted in 1988 to the International Convention for Safety of Life at Sea ("SOLAS"). Compliance with SOLAS convention requirements such as GMDSS was a component of the Vessel's ACP participation. Specifically, GMDSS requirements are set forth in Chapter IV of the SOLAS regulations entitled "*RADIOCOMMUNICATIONS*."

[11] Utilizing advancements in satellite and digital technologies, GMDSS was designed to ensure maximum availability of safety information aboard ships engaged in international voyages. In essence, the system endeavors to guarantee that any GMDSS-equipped vessel is able to communicate with a shore station at any time and from any location to exchange distress or other safety-related information.[6] Such safety information includes reception of weather forecast data from multiple sources.

[12] The specific individual GMDSS components that any particular vessel must be equipped with are dependent upon the waters in which it is operating. However, regardless

[6] *GMDSS Guide:* Furuno, n.d., https://www.furunousa.com/ProductDocuments/GMDSS Guide.pdf. Accessed May 9, 2016.

of the waters being operated in, all GMDSS-regulated vessels must carry the following equipment in addition to that required for their operating region:

- two or more VHF handheld radios ("walkie-talkies");
- two or more Search and Rescue Transponders ("SART");[7]
- an Emergency Position Indicating Radio Beacon ("EPIRB");[8] and
- a "NAVTEX" receiver (see description *infra*).

[13] In very simplified terms, references to radio frequencies utilized for electronic data transmission and associated coverage areas may be summarized as follows:

> **MF** "Medium Frequency" – refers to the radio spectrum between 300 kilohertz ("KHz") and 3000 KHz (or 3 megahertz ("MHz")), which includes the typical AM radio broadcast frequencies between 540 KHz and 1600 KHz. Range is typically on the order of several hundred miles by day and perhaps 1000 miles or more at night.
>
> **HF** "High Frequency" – refers to the radio spectrum between 3 MHz and 30 MHz, which includes many international shortwave broadcast frequencies. Depending on frequency used and time of day, range is typically several thousand miles or more.
>
> **VHF** "Very High Frequency" – marine VHF frequencies are in the 156 to 162 MHz area of the radio spectrum, which is slightly higher than typical FM radio broadcast frequencies that are between 88 MHz and 108 MHz. Range is typically on the order of 25 to perhaps 50 miles from the transmitting station.
>
> **INMARSAT** The INMARSAT-C system operates in the Ultra-High Frequency ("UHF") portion of the radio spectrum at 1500-1600 MHz. The system consists of a network of 12 satellites in "geosynchronous" orbits[9] that provide worldwide coverage (with the exception of polar regions above 80° latitude).

[14] Oceangoing ships such as the Vessel are typically outfitted with, in addition to the previously referenced equipment that must be carried aboard all GMDSS-regulated vessels, a MF/HF single sideband ("SSB") radiotelephone receiver as well as an INMARSAT-C Mobile Earth Station ("MES") terminal. Also, it should be noted that GMDSS regulations require certain components such as the INMARSAT-C terminal to be fitted in duplicate, to provide system redundancy. Typical equipment in a GMDSS installation would be located somewhere within the ship's navigating bridge area and would enable the following electronic data reception capabilities:

> **INMARSAT-C** ("Sat-C") – this satellite-based system is a two-way data service operated by the telecommunications company Inmarsat. This system exchanges transmissions of data only; voice communication is not possible with INMARSAT-C. Broadly speaking, INMARSAT-C may be thought of as an "open-ocean" version of NAVTEX (described below). Regular transmissions

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7 SART devices are radar-activated transponders used to locate a survival craft or a ship in distress by presenting a series of dot's on a rescuing ship's radar display.

8 An EPIRB is a "float-free," automatically activated device that transmits a distress signal that can be detected by satellites on a designated radio frequency.

9 Objects in a geosynchronous orbit appear to remain in a fixed position with respect to any given point on the rotating earth's surface.

via this medium include those of "Inmarsat-C SafetyNET," which is an internationally adopted, automated satellite system for promulgating weather forecasts and warnings, marine navigational warnings and other safety related information to all types of vessels and is part of the GMDSS. SafetyNET broadcasts are performed using the Inmarsat satellite system of geostationary satellites. The NWS prepares high seas forecasts and warnings for broadcast via SafetyNET for each of three different ocean areas four times daily. These broadcasts are prepared cooperatively by the Ocean Prediction Center, NHC and Honolulu Forecast Office.[10] Regularly scheduled transmissions for the Atlantic Ocean area commence at (UTC[11]) 4:30 am, 10:30 am, 4:30 pm and 10:30 pm, however, such transmissions are supplemented on an "as needed" basis during hurricane activity.

NAVTEX - short for "Navigational Telex," NAVTEX is an automated medium frequency system for broadcasting text over radio. There are stations located worldwide and, in the United States, transmissions originate from US Coast Guard radio stations located along Atlantic, Gulf and Pacific coasts, as well as in Alaska and Hawaii.[12] The system operates at 518 KHz and has a typical range on the order of 200-300 miles. A dedicated shipboard NAVTEX receiver is connected to a printer that provides hard copies of the telex/text transmissions. Typical broadcasts include information such as navigational warnings, meteorological warnings, ice reports, search and rescue information, etc. With regard to weather information, the Coast Guard stations transmit the various NWS marine forecasts and warnings at regularly scheduled 4-hour intervals. In the southeast US region, broadcasts originate from Charleston, SC; New Orleans, LA; Miami, FL; and San Juan, PR. At the time of the subject incident, the Vessel was likely within receiving range of the Miami and/or the San Juan broadcasts. The schedule of daily transmissions commences at midnight (0000) UTC for Miami and 2:50 am (0250) UTC for San Juan - transmissions from both continue at 4-hour intervals thereafter.

WEFAX - short for "Weather Facsimile," WEFAX is also known as HF FAX or radiofacsimile. It is a means of broadcasting surface weather maps via HF radio (although the term is also used to refer to reception of weather charts and imagery via satellite). There are transmitting stations located worldwide; in the United States, the NWS provides such surface maps for facsimile transmission by USCG coast stations including Boston and New Orleans on various HF radio frequencies at regularly scheduled intervals. Boston transmissions are scheduled to commence at (UTC) 2:30 am, 7:45 am, 2:00 pm, 5:20 pm and 7:00 pm. New Orleans broadcasts are scheduled to commence at (UTC) midnight, 6:00 am, noon and 6:00 pm. Maps/surface imagery are received using a dedicated radiofax receiver or an SSB

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10 "INMARSAT-C Safety Net." *National Weather Service*, January 7, 2014, http://www.nws.noaa.gov/om/marine/inmarsat.htm. Accessed May 9, 2016.

11 UTC refers to "Universal Coordinated Time," otherwise known as Greenwich Mean Time ("GMT") or Zulu ("Z") – it equates to Eastern Standard Time ("EST") minus 5 hours or Eastern Daylight Time ("EDT") minus 4 hours, e.g., 6:00 am UTC is 1:00 am EST or 2:00 am EDT.

12 "NAVTEX Maritime Safety Broadcasts." *USCG*, September 8, 2016, http://www.navcen.uscg.gov/?pageName=NAVTEX. Accessed February 22, 2017.

radiotelephone receiver connected to an external facsimile recorder or PC with a radiofax interface and software.[13] The NWS maps are also made available for transmission via the INMARSAT-C system.

HF VOICE BROADCASTS - the USCG broadcasts National Weather Service high seas forecasts and storm warnings from six high seas communication stations including two located in Chesapeake, VA and New Orleans, LA.[14] Broadcasts occur in the SSB voice mode at regular intervals on multiple HF frequencies so as to be receivable at any time of day and at any distance from the transmitting stations out to several thousand miles or more. As the Vessel's GMDSS console was required to include an HF SSB receiver, the ship was capable of receiving HF voice broadcasts of NWS information at the time of the subject incident.[15]

Additional SOLAS equipment requirements

[15] The question arose in the USCG Marine Board of Investigation hearings whether the Vessel was required to be fitted with an anemometer for the purpose of determining and displaying relative wind speeds. The answer to that question is "no," the Vessel was not required to carry an anemometer. Additional bridge equipment and/or instrumentation requirements for SOLAS-compliant ships such as the Vessel are set forth in Chapter V of the SOLAS regulations entitled "*Safety of navigation*." Specifically, Regulation 19 of SOLAS Chapter V identifies "*Carriage requirements for shipborne navigational systems and equipment*" and includes items such as magnetic and gyro compasses, radar installations and electronic plotting aids, satellite navigation equipment, fathometer (depth finder), etc. A review of Regulation 19, as well as all of the other SOLAS Chapter V Regulations, confirms that there is no requirement for ships such as the Vessel to carry any type of meteorological instrumentation (which would include an anemometer). This was further corroborated by review of the Vessel's 2015 SOLAS Cargo Ship Safety Equipment Certificate and 2015 ABS Cargo Ship Safety Equipment Record which confirm the anemometer was not required. [16]

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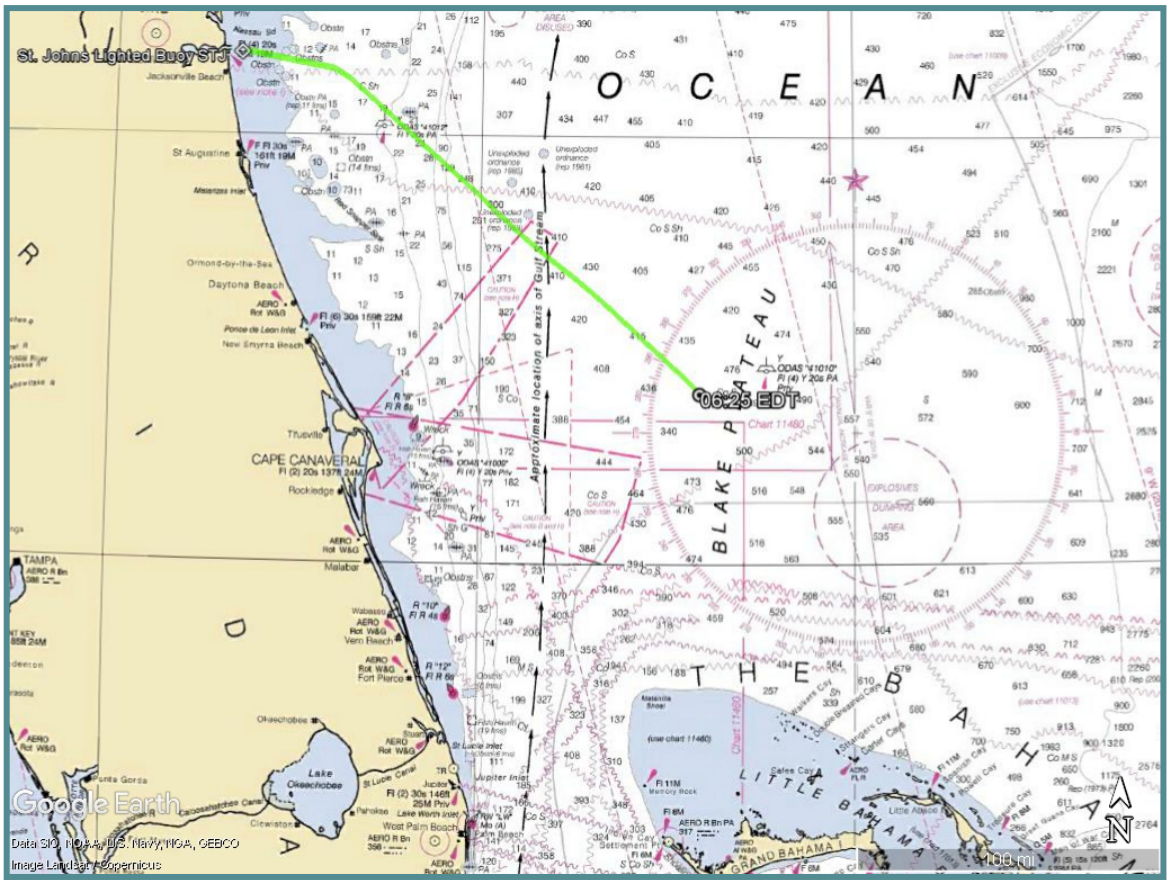
[13] "NWS Radiofax." *National Weather Service*, May 4, 2015, http://www.nws.noaa.gov/om/marine/radiofax.htm. Accessed May 9, 2016.

[14] "USCG HF Voice." *National Weather Service*, March 26, 2015, http://www.nws.noaa.gov/om/marine/hfvoice.htm. Accessed May 9, 2016.

[15] Additionally, while not a component of GMDSS regulations, many oceangoing vessels have the capability of accessing the internet via cellular or satellite connections. It is understood that the Vessel did not have continuous satellite internet access.

[16] However, Regulation 5 of SOLAS Chapter V is entitled "*Meteorological services and warnings*" and explains that some ships might be fitted with an anemometer as part of an entirely voluntary program in which selected ships furnish regular weather observations in accordance with the World Meteorological Organization ("WMO") reporting system. Aboard US ships, such activity is conducted as part of the NWS "*VOLUNTARY OBSERVING SHIP (VOS) PROGRAM*." Per the NWS web site at http://www.nws.noaa.gov/directives/010/archive/pd01023001a.pdf, "*A* [VOS] *ship should have at least a barometer, a thermometer to measure Sea Surface Temperature, a psychrometer (for Air Temperature and humidity), a barograph and possibly an anemometer*." (emphasis added)

Voyage Stage 1 – departure from Jacksonville



[16] The light green line in the above illustration depicts the Vessel's actual track from Lighted Buoy STJ to the point at which the captain implemented the first of two course deviations to allow for more distance between the ship and the developing storm system (which was at approximately 6:25 am EDT on September 30, 2015). The Vessel undocked from its berth in Jacksonville, FL at approximately 8:15 pm EDT on September 29, 2015 (Sep. 30/12:15 am UTC). Allowing for necessary time to arrange for and deploy requisite pilot, tugboats, linehandlers, etc. to accomplish the undocking operation, it is evident that the decision to get underway was made at some time prior to 7:00 pm EDT that evening. At such time, the latest information regarding the developing *JOAQUIN* storm system from the NHC was Advisory Number 8, prepared at 5:00 pm EDT on September 29. Advisory 8 text that was included in subsequent electronic data transmissions, as excerpted from the NTSB Meteorological Group Report, has been reproduced on the following page.[17]

[17] NHC Advisory information was being received on the bridge of the Vessel by the previously described Sat-C and/or other electronic reception equipment.

WTNT31 KNHC 292051
TCPAT1

BULLETIN
TROPICAL STORM JOAQUIN ADVISORY NUMBER 8
NWS NATIONAL HURRICANE CENTER MIAMI FL AL112015
ISSUED BY THE NWS WEATHER PREDICTION CENTER COLLEGE PARK MD
500 PM EDT TUE SEP 29 2015

...JOAQUIN CONTINUES TO STRENGTHEN...

SUMMARY OF 500 PM EDT...2100 UTC...INFORMATION

LOCATION...26.0N 71.0W
ABOUT 405 MI...650 KM E OF THE NORTHWESTERN BAHAMAS
MAXIMUM SUSTAINED WINDS...65 MPH...100 KM/H
PRESENT MOVEMENT...WSW OR 240 DEGREES AT 5 MPH...7 KM/H
MINIMUM CENTRAL PRESSURE...990 MB...29.24 INCHES

WATCHES AND WARNINGS

There are no coastal watches or warnings in effect.

Interests in the Bahamas should monitor the progress of Joaquin.
Watches or warnings may be issued for portions of the Bahamas later
this evening.

DISCUSSION AND 48-HOUR OUTLOOK

At 500 PM EDT (2100 UTC), the center of Tropical Storm Joaquin was
located near latitude 26.0 North, longitude 71.0 West. Joaquin is
moving toward the west-southwest near 5 mph (7 km/h) and this
general motion is expected to continue for the next couple of days.

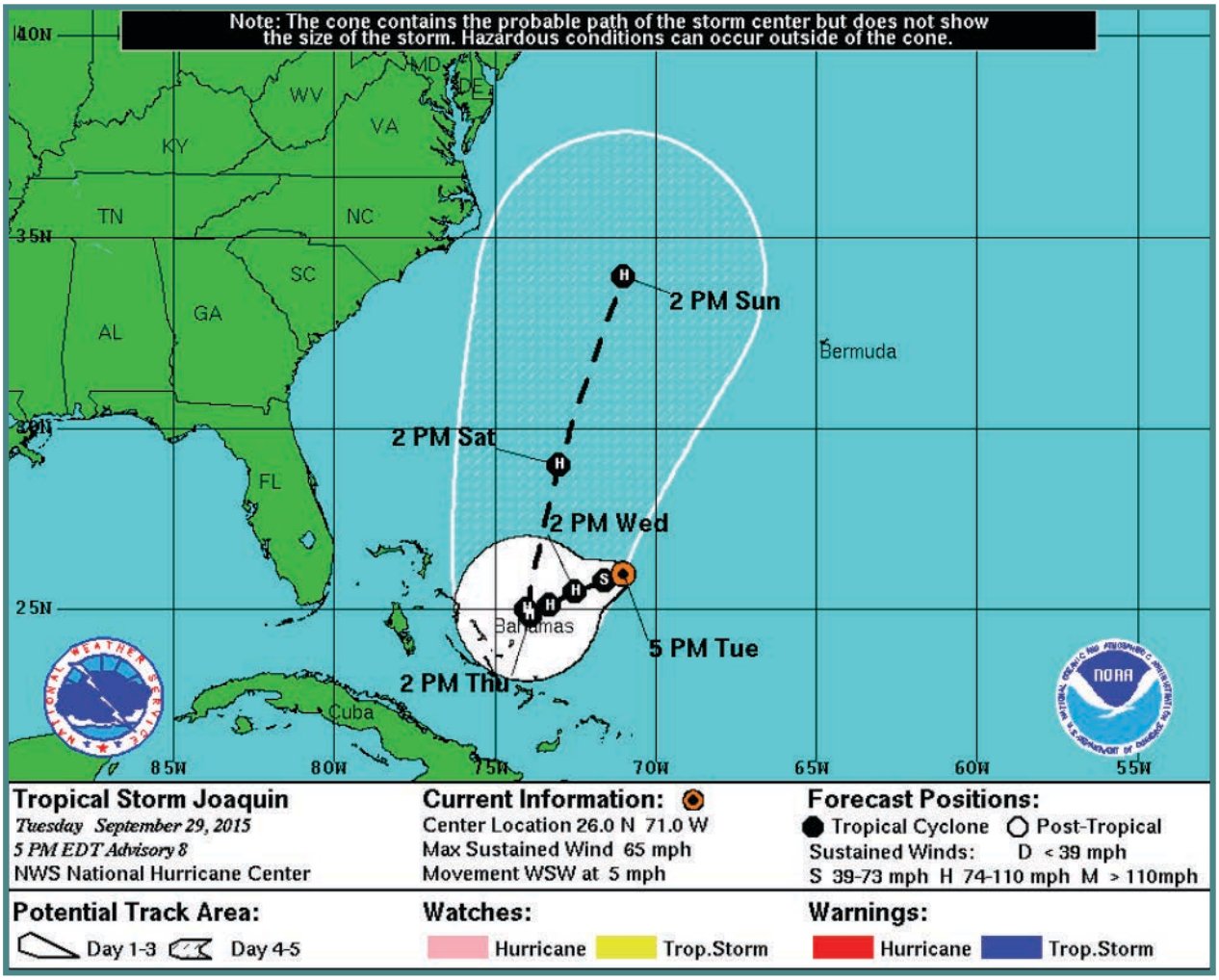
Reports from an Air Force Hurricane Hunter aircraft indicate that
the maximum sustained winds have increased to near 65 mph (100 km/h)
with higher gusts. Additional strengthening is forecast during
the next 48 hours, and Joaquin could become a hurricane on
Wednesday.

Tropical storm force winds extend outward up to 90 miles (150 km)
from the center.

[17] Per the broadcast text, *JOAQUIN* was a tropical storm at the time, generating maximum sustained winds of 65 mph out to a radius of 90 miles from its center. The storm was expected to strengthen, however, no coastal warnings or watches were put in place at that time. The forecast was for tropical storm force winds (sustained velocity > 34 knots) to reach the central Bahama Islands by the morning of October 1.

[18] The projected track of the storm, per Advisory Number 8 and illustrated by the graphic reproduced on the following page from the NTSB Meteorological Group Report, was for continued movement to the west-southwest through the morning of October 1 followed by a pronounced recurve to the north-northwest at a point more than 80 nautical miles from the central Bahama Islands. Such pronounced northward turn of the storm would be

consistent with a common track for cyclonic low-pressure systems in this area. Moreover, having not yet entered the open Atlantic Ocean at the time this NHC Advisory was issued, the Vessel's captain had multiple route options available both north and south of the Bahamas chain with regard to the track the Vessel would ultimately follow to San Juan. Accordingly, given the forecast weather data and available vessel track options, the captain's decision to depart from the Port of Jacksonville at 8:15 pm EDT on the evening of September 29, 2015 is considered reasonable.



Voyage Stage 2 – first course change for additional distance from developing storm

[19] The light green line in the above illustration depicts the Vessel's actual track after the captain implemented the first of two course deviations to allow for more distance between the Vessel and the developing storm. The first deviation entailed a course change from about 133° to about 141° at approximately 6:25 am EDT (0625 EDT) on September 30, 2015. It then shows the Vessel's actual progress up to 7:05 pm EDT (1905 EDT) that evening. During that day, by an email sent to TOTE shoreside operations personnel at 1:22 pm EDT (5:22 pm UTC), the Vessel's captain advised that he had been observing the erratic track of *JOAQUIN* for the better part of a week and that the storm now appeared to be tracking as forecast. He advised further that he had adjusted the normal direct track of the Vessel to the south-southeast so as to pass approximately 65 miles to the south of the storm's track and be on the "back" side of *JOAQUIN* by the morning of October 1. At such time, the latest information regarding the developing *JOAQUIN* storm system from the NHC was Advisory Number 11, prepared at 11:00 am EDT on September 30. Advisory 11 text that was included in subsequent electronic data transmissions, as excerpted from the NTSB Meteorological Group Report, has been reproduced on the following page.

[20] Per Advisory Number 11, *JOAQUIN* had achieved hurricane status, now generating maximum sustained winds of 80 mph (hurricane status requires sustained winds greater than 74 mph). As expressly stated in Advisory Number 11, the radius of hurricane force winds was 35 miles outward from its center, while tropical storm force winds extended 125 miles from the center. Also, a hurricane warning had been issued for the central Bahama Islands.

WTNT31 KNHC 301453
TCPAT1

BULLETIN
HURRICANE JOAQUIN ADVISORY NUMBER 11
NWS NATIONAL HURRICANE CENTER MIAMI FL AL112015
1100 AM EDT WED SEP 30 2015

...JOAQUIN STRENGTHENS SOME MORE AS IT MOVES SOUTHWESTWARD TOWARD
THE CENTRAL BAHAMAS...

SUMMARY OF 1100 AM EDT...1500 UTC...INFORMATION

LOCATION...24.7N 72.6W
ABOUT 215 MI...345 KM ENE OF THE CENTRAL BAHAMAS
MAXIMUM SUSTAINED WINDS...80 MPH...130 KM/H
PRESENT MOVEMENT...SW OR 230 DEGREES AT 6 MPH...9 KM/H
MINIMUM CENTRAL PRESSURE...971 MB...28.68 INCHES

WATCHES AND WARNINGS

CHANGES WITH THIS ADVISORY:

None.

SUMMARY OF WATCHES AND WARNINGS IN EFFECT:

A Hurricane Warning is in effect for...
* Central Bahamas including Cat Island, the Exumas, Long Island, Rum Cay, and San Salvador.

A Hurricane Watch is in effect for...
* Northwestern Bahamas including the Abacos, Berry Islands, Bimini, Eleuthera, Grand Bahama Island, and New Providence, but excluding Andros Island

A Hurricane Warning means that hurricane conditions are expected somewhere within the warning area. Preparations to protect life and property should be rushed to completion.

A Hurricane Watch means that hurricane conditions are possible within the watch area.

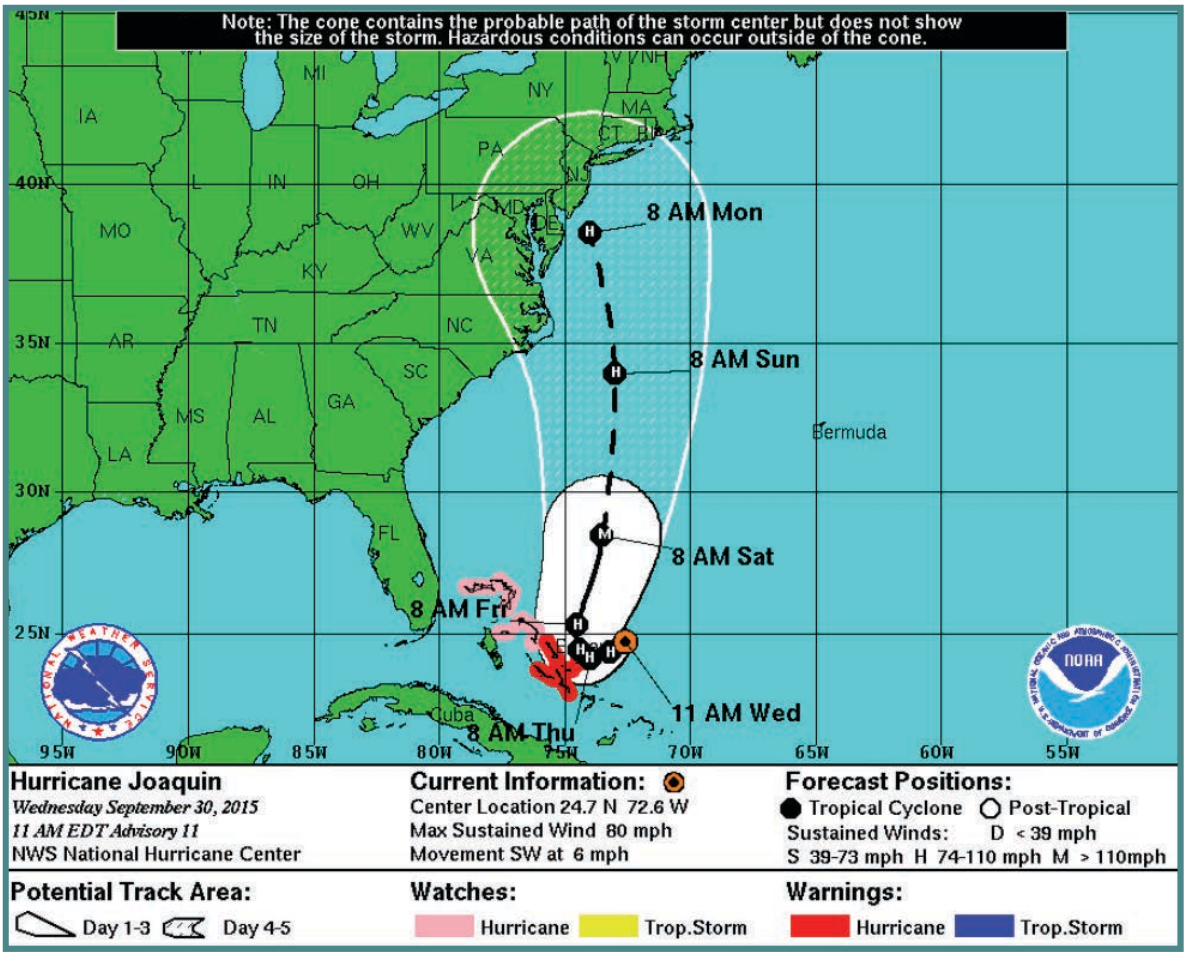
DISCUSSION AND 48-HOUR OUTLOOK

At 1100 AM EDT (1500 UTC), the center of Hurricane Joaquin was located near latitude 24.7 North, longitude 72.6 West. Joaquin is moving toward the southwest near 6 mph (9 km/h). A general motion toward the west-southwest or southwest is expected to continue through tonight. A turn toward the northwest and a decrease in forward speed are forecast Thursday or Thursday night. The center of Joaquin is expected to move near or over portions of the central Bahamas tonight and Thursday.

Reports from an Air Force Reserve Hurricane aircraft indicate that maximum sustained winds have increased to near 80 mph (130 km/h) with higher gusts. Additional strengthening is expected, and Joaquin could become a major hurricane during the next couple of days.

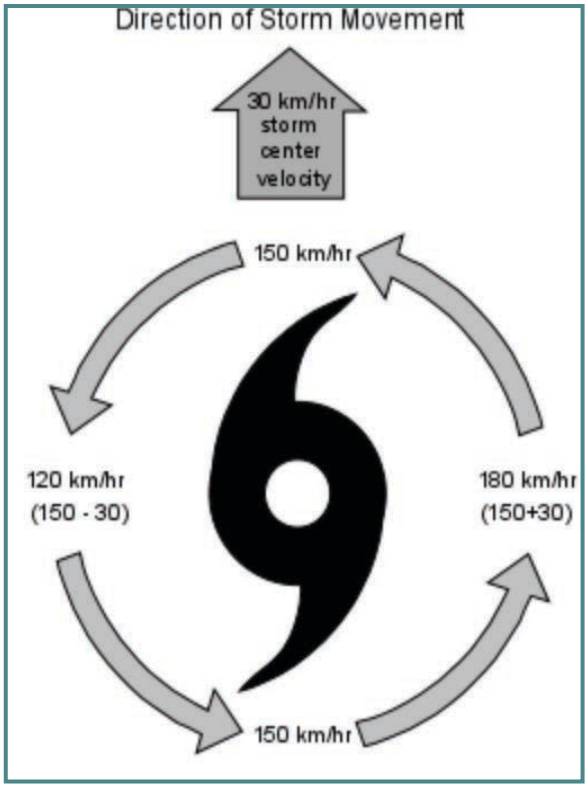
Hurricane force winds extend outward up to 35 miles (55 km) from the center and tropical storm force winds extend outward up to 125 miles (205 km).

[21] The projected track of the storm, per Advisory Number 11 and illustrated by the graphic reproduced below from the NTSB Meteorological Group Report, still included the pronounced recurve to the north-northwest by 8:00 am EDT on the morning of October 1.



[22] Any evaluation of the captain's decision to continue along such course must take two important factors into consideration. The first is the fact that the geographical dimensions of *JOAQUIN* were substantially smaller in area than is typical for hurricanes occurring in North Atlantic Ocean waters and the planned track of the vessel would have been well outside the radius of hurricane force winds. The second consideration involves vessel position relative to the storm's track. Basically speaking, all cyclonic storms assume the shape of a circle. In the northern hemisphere, the "half-circle" that lies to the right of the storm's track is referred to as the "dangerous semi-circle." The "half-circle" that lies to the left of the storm's track is referred to as the "navigable semi-circle." A somewhat over-simplified explanation for these terms begins with the fact that winds surrounding all low-pressure systems move in a counter-clockwise direction (in the northern hemisphere) as shown by the illustration on the following page.

[23] As is readily apparent, a vessel meeting such a storm and coming down the right side of its track encounters strong headwinds and head seas that cause heavy pitching and rolling motions, with considerable pounding of the vessel's structure as it plows ahead into such conditions. Conversely, a vessel coming down the left side of that storm track encounters less strong[18] and predominantly "following" winds and seas that result in a gentler ride and minimal structural pounding. That is why the left semi-circle is deemed "navigable." Accordingly, the captain's plan to adjust course so as to pass south of *JOAQUIN* and on its "back" side would have kept the Vessel in the storm's navigable semi-circle. At a distance of 65 miles from the storm's center, the Vessel would have remained well outside the radius of hurricane force winds, and encountered only the predominantly following winds and seas of its navigable semi-circle.



[24] On the basis of the forecast information and projected storm system track available to the Vessel at the time, the captain's estimation that the Vessel would pass "under" (south of) the storm's path, approximately 65 miles from its center, was accurate and manageable. Accordingly, the captain's decision to continue along the selected course is considered reasonable.

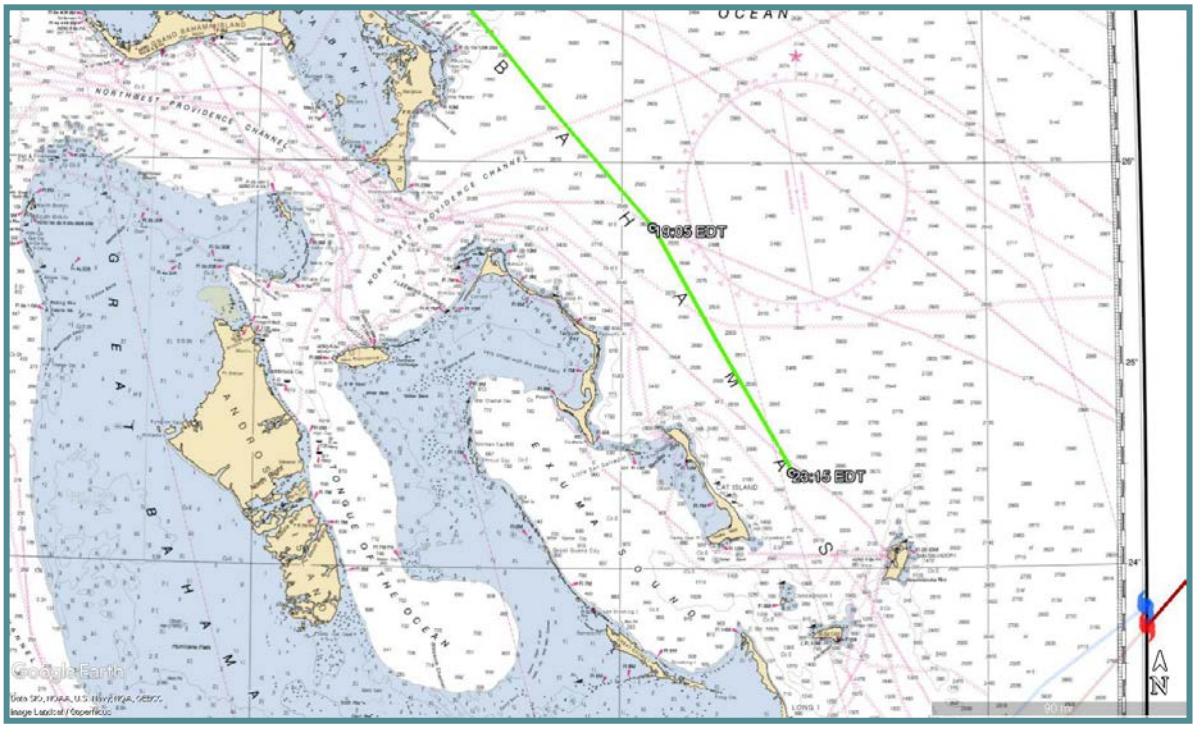
Voyage Stage 3 – second course change for additional distance from *JOAQUIN*

[25] At approximately 5:15 pm EDT on September 30, 2015, the chief mate received the information in Advisory Number 12 via the Sat-C reception terminal of the Vessel's GMDSS. After processing the information received, he noted that the storm's position was further to the south and west than had been previously forecast and he then plotted the projected positions of both *JOAQUIN* and the Vessel for 2:00 am EDT on October 1. A discussion of those results with the captain ensued, culminating in a decision to check the next weather update from BVS around 6:00 pm EDT. That BVS data confirmed that the storm had tracked further to the south than previously forecast. Subsequent discussions between the chief mate and captain resulted in the decision to alter course further to the south, to pass inside

[18] As the circulation illustration demonstrates, relative wind velocities encountered in the dangerous semi-circle are increased by the system's speed of forward travel, while relative wind velocities encountered in the navigable semi-circle are reduced by that same forward speed factor. That is why any cyclonic system's navigable semi-circle always entails significantly less strong winds.

of San Salvador Island and thus be even further away from the storm's center versus the 2:00 am EDT positions that the chief mate had plotted after reviewing Advisory Number 12. That second course change was then implemented at approximately 7:05 pm EDT.

[26] The light green line in the illustration below depicts the Vessel's actual track after the captain implemented a second course deviation further to the south to allow for even more distance between the ship and the developing storm system, which second deviation entailed a course change from about 139° to about 150° at approximately 7:05 pm EDT (1905 EDT/2305 UTC) on September 30, 2015. The track line then shows the Vessel's actual progress up to 11:15 pm EDT (2315 EDT/0315 UTC) of that same evening. The two storm icons in the lower right corner of the illustration below indicate *JOAQUIN*'s forecast (blue icon) position/track, as well as its best (red icon) position/track as determined by the NHC post-incident and identified in the NTSB Meteorological Group Report.



[27] At the time of the second course change, the latest information regarding the developing *JOAQUIN* storm system from the NHC was Advisory Number 12, prepared at 5:00 pm EDT on September 30. Advisory 12 text that was included in subsequent electronic data transmissions, as excerpted from the NTSB Meteorological Group Report, has been reproduced on the following page. Per Advisory Number 12, now-hurricane *JOAQUIN* was generating maximum sustained winds of 85 mph. As expressly stated in Advisory Number 12, the radius of hurricane force winds was still 35 miles outward from its center, with tropical storm force winds extending 125 miles from the center. A hurricane warning had been issued for the northwestern Bahama Islands, however, the southeastern Bahama Islands, including Acklins and Crooked Island, were still only under a tropical storm warning.

WTNT31 KNHC 302050
TCPAT1

BULLETIN
HURRICANE JOAQUIN ADVISORY NUMBER 12
NWS NATIONAL HURRICANE CENTER MIAMI FL AL112015
500 PM EDT WED SEP 30 2015

...JOAQUIN MOVING SOUTHWESTWARD TOWARD THE CENTRAL BAHAMAS...

SUMMARY OF 500 PM EDT...2100 UTC...INFORMATION

LOCATION...24.3N 73.1W
ABOUT 175 MI...285 KM ENE OF THE CENTRAL BAHAMAS
MAXIMUM SUSTAINED WINDS...85 MPH...140 KM/H
PRESENT MOVEMENT...SW OR 225 DEGREES AT 8 MPH...13 KM/H
MINIMUM CENTRAL PRESSURE...967 MB...28.56 INCHES

WATCHES AND WARNINGS

CHANGES WITH THIS ADVISORY:

The Government of the Bahamas has issued a Hurricane Warning for the Northwestern Bahamas including the Abacos, Berry Islands, Eleuthera, Grand Bahama Island, and New Providence, but excluding Andros Island and Bimini.

The Government of the Bahamas has issued a Tropical Storm Warning for the Southeastern Bahamas, including the Acklins, Crooked Island, Long Cay, the Inaguas, Mayaguana, and the Ragged Islands, but excluding the Turks and Caicos Islands.

SUMMARY OF WATCHES AND WARNINGS IN EFFECT:

A Hurricane Warning is in effect for...
* Central Bahamas including Cat Island, the Exumas, Long Island, Rum Cay, and San Salvador
* Northwestern Bahamas including the Abacos, Berry Islands, Eleuthera, Grand Bahama Island, and New Providence, but excluding Andros Island and Bimini

A Hurricane Watch is in effect for...
* Bimini

A Tropical Storm Warning is in effect for...
* Southeastern Bahamas including the Acklins, Crooked Island, Long Cay, the Inaguas, Mayaguana, and the Ragged Islands, but excluding the Turks and Caicos Islands.

A Hurricane Warning means that hurricane conditions are expected somewhere within the warning area. Preparations to protect life and property should be rushed to completion.

A Hurricane Watch means that hurricane conditions are possible within the watch area.

A Tropical Storm Warning means that tropical storm conditions are expected somewhere within the warning area within 36 hours.

For storm information specific to your area, please monitor products issued by your national meteorological service.

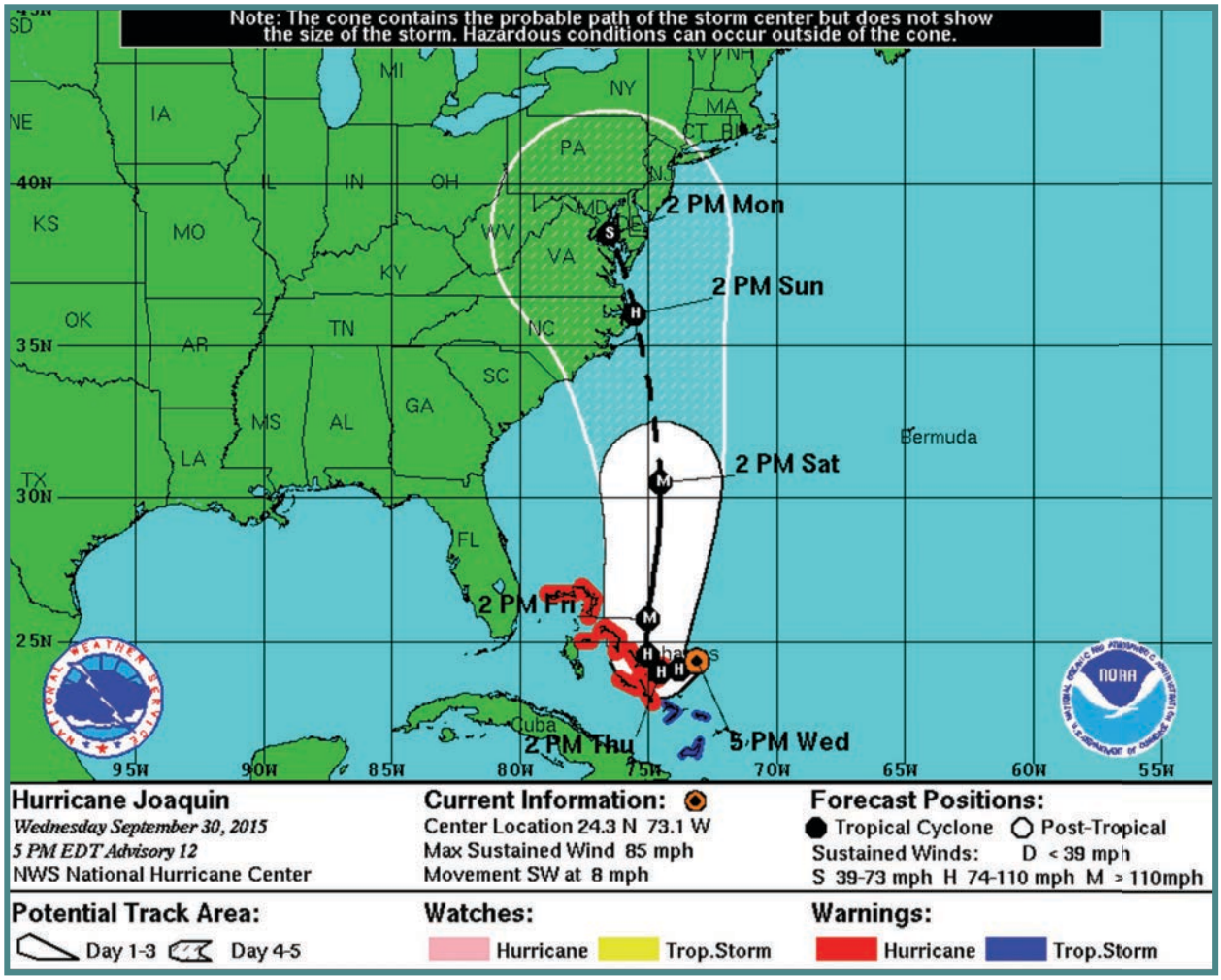
DISCUSSION AND 48-HOUR OUTLOOK

At 500 PM EDT (2100 UTC), the center of Hurricane Joaquin was located near latitude 24.3 North, longitude 73.1 West. Joaquin is moving toward the southwest near 8 mph (13 km/h), and this general motion is expected to continue through Thursday. A turn toward the northwest and north is expected Thursday night and Friday. The center of Joaquin is expected to move near or over portions of the central Bahamas tonight and Thursday, and near or over portions of the Northwestern Bahamas Thursday night or Friday.

Maximum sustained winds are near 85 mph (140 km/h) with higher gusts. Strengthening is forecast during the next 48 hours, and Joaquin could become a major hurricane by Friday.

Hurricane force winds extend outward up to 35 miles (55 km) from the center and tropical storm force winds extend outward up to 125 miles (205 km).

[28] The projected track of the storm, per Advisory Number 12 and illustrated by the graphic reproduced on the following page from the NTSB Meteorological Group Report, still included the pronounced recurve to the north-northwest, however, this change in direction was now forecast to not occur until the evening of October 1. Nonetheless, the implementation of the second course adjustment further to the south, with its resulting greater separation from the storm's center, suggested that the Vessel would now pass nearest to *JOAQUIN* to the northeast of Acklins and Crooked Island. In such position, the Vessel would still be on the "back" side of the storm system and in its navigable semi-circle, while also remaining well outside the radius of hurricane force winds.



[29] On the basis of the forecast information and projected storm system track available to the Vessel at the time, the captain's plan to alter course further to the south so as to achieve even greater separation, while still remaining in the storm system's navigable semi-circle and well outside the radius of hurricane force winds is considered reasonable.

Voyage Stage 4 – events following the 11:00 pm weather update

[30] Shortly after 11:00 pm EDT on September 30, 2015, the NHC issued further information regarding the *JOAQUIN* storm system in the form of Advisory Number 13. Text of this Advisory that was included in the associated electronic data transmission, as excerpted from the NTSB Meteorological Group Report, has been reproduced below.

WTNT31 KNHC 010249
TCPAT1

BULLETIN
HURRICANE JOAQUIN ADVISORY NUMBER 13
NWS NATIONAL HURRICANE CENTER MIAMI FL AL112015
1100 PM EDT WED SEP 30 2015

...JOAQUIN BECOMES A CATEGORY 3 HURRICANE AS IT MOVES TOWARD THE CENTRAL BAHAMAS...

SUMMARY OF 1100 PM EDT...0300 UTC...INFORMATION

LOCATION...23.8N 73.1W
ABOUT 90 MI...145 KM E OF SAN SALVADOR
ABOUT 170 MI...275 KM E OF THE CENTRAL BAHAMAS
MAXIMUM SUSTAINED WINDS...115 MPH...185 KM/H
PRESENT MOVEMENT...SW OR 220 DEGREES AT 6 MPH...9 KM/H
MINIMUM CENTRAL PRESSURE...951 MB...28.09 INCHES

DISCUSSION AND 48-HOUR OUTLOOK

At 1100 PM EDT (0300 UTC), the center of Hurricane Joaquin was located near latitude 23.8 North, longitude 73.1 West. Joaquin is moving toward the southwest near 6 mph (9 km/h) and this general motion is expected to continue over the next 24 hours. A turn toward the northwest and north is forecast Thursday night or Friday. The center of Joaquin is expected to move near or over portions of the central Bahamas overnight and Thursday, and be near or over portions of the Northwestern Bahamas Thursday night or Friday.

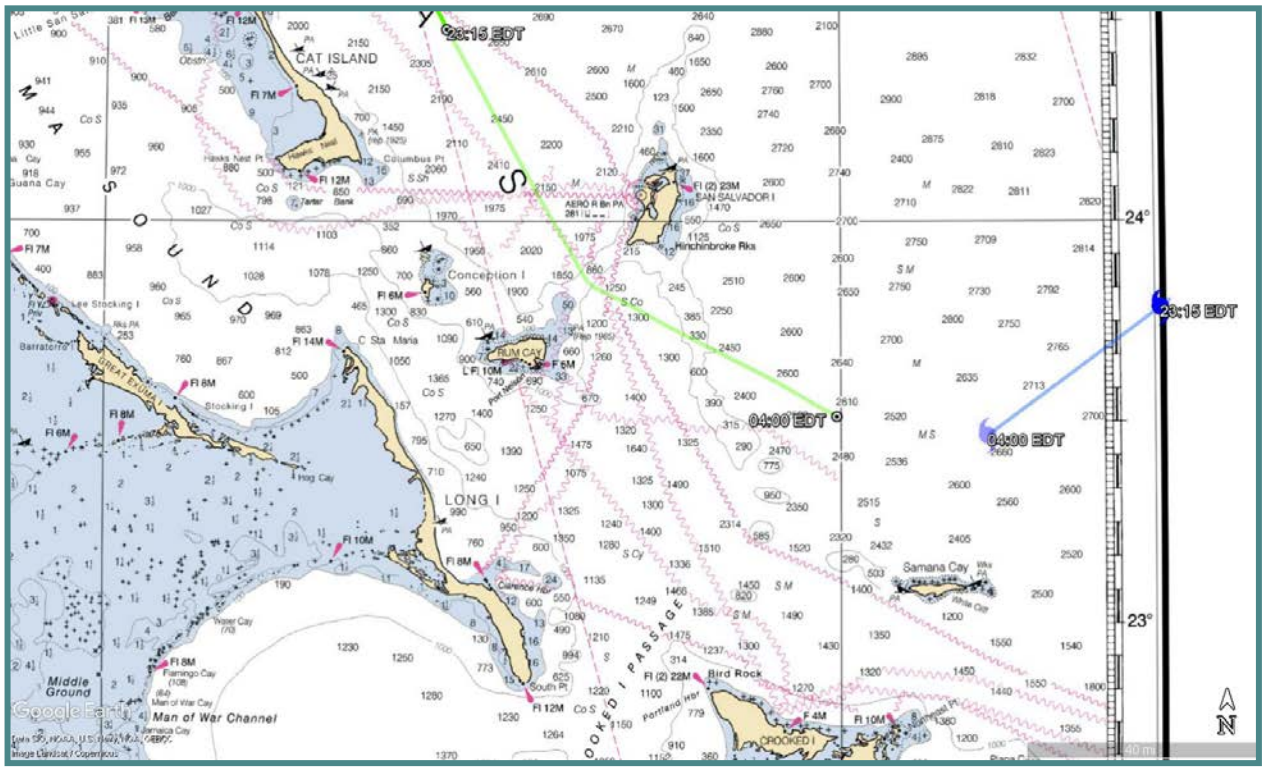
Data from an Air Force Reserve Hurricane Hunter Aircraft indicate that maximum sustained winds have increased to near 115 mph (185 km/h) with higher gusts. Joaquin is a category 3 hurricane on the Saffir-Simpson Hurricane Wind Scale. Additional strengthening is forecast during the next day or so. Some fluctuations in intensity are possible Thursday night and Friday.

Hurricane-force winds extend outward up to 35 miles (55 km) from the center and tropical-storm-force winds extend outward up to 140 miles (220 km).

[31] The second course deviation implemented by the Vessel's captain entailed a track that took the Vessel to the inside (south) of San Salvador Island. Once past San Salvador, the plan was to then return to an east-southeasterly heading (on a course of 116°) to start bringing the Vessel back to its usual track for San Juan.

[32] Aboard the Vessel, the third mate on watch received the Advisory 13 information via the Vessel's Sat-C terminal at approximately 11:05 pm EDT and noted the latest storm position and forecast track. He recognized that the storm had intensified to a Category 3 system, that its center was further south than originally anticipated and that it was continuing to move in a southwesterly direction that would bring it closer than expected to the Vessel's track after the course change back to the east was made past San Salvador Island. According to the bridge audio transcript from the recovered VDR, the third mate telephoned the captain in his stateroom and suggested he might want to review the latest storm information that was just received on the bridge. He then plotted the latest forecast track for *JOAQUIN* against the projected Vessel track, concluding that the Vessel would now be 22 miles from the storm's center between 4:00 and 4:30 am EDT on October 1. He telephoned the captain again to advise him of this updated plot information. It appears that the captain's response was that he believed the Vessel would be on the south side of the storm (in the navigable semi-circle), so the winds would not be an issue.

[33] The illustration below depicts the above-described scenario plotted by the third mate. It shows the Vessel's actual position at 11:15 pm EDT (2315 EDT) on September 30, as well as a projected position for 4:00 am EDT (0400 EDT) on October 1. It also shows *JOAQUIN*'s 11:15 pm EDT position and its forecast position for 4:00 am EDT.



[34] Contrary to the captain's perception of the storm's location, the latest track forecast for *JOAQUIN*'s position as plotted out by the third mate showed the storm crossing directly ahead of the Vessel, at a distance of approximately 22 miles. Of additional concern would be the fact that the Vessel would now be in the system's dangerous semi-circle, with its stronger winds and head seas. The captain's perception of *JOAQUIN*'s position at that time may have been impacted by the BVS information that he had previously reviewed with the chief mate around 6:00 pm EDT. The illustration below, reproduced from the NTSB Meteorological Group Report, represents the BVS image that was downloaded aboard the Vessel shortly before 6:00 pm EDT on September 30, 2015, which image shows the forecast position of the storm for 2:00 am EDT on October 1. As compared to the 2:00 am EDT storm position along the track plotted by the third mate from NHC Advisory 13, that earlier BVS prediction placed the storm center over 40 miles further to the north. Had this BVS information been accurate, the Vessel would indeed have passed well to its south side and in its navigable semi-circle. However, post-incident records confirm that this was not the case. Regardless, this may be why the captain did not come up to the Vessel's bridge to review the 11:05 pm EDT Sat-C information that the third mate had discussed with him by telephone.

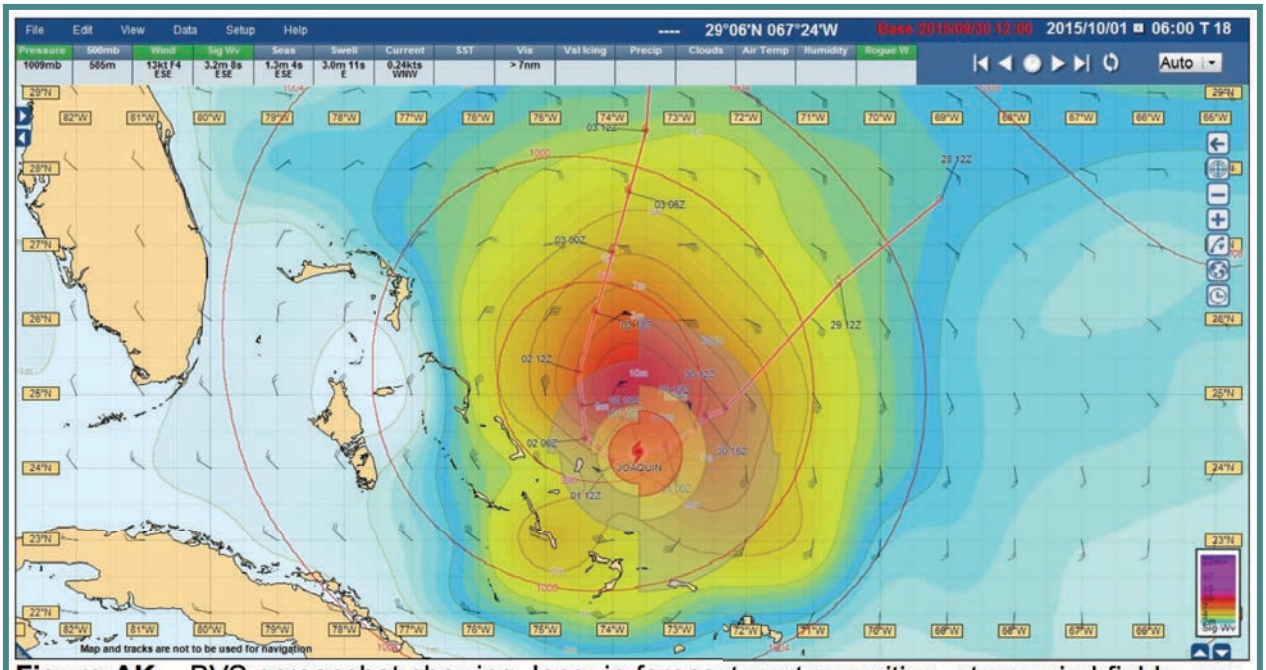
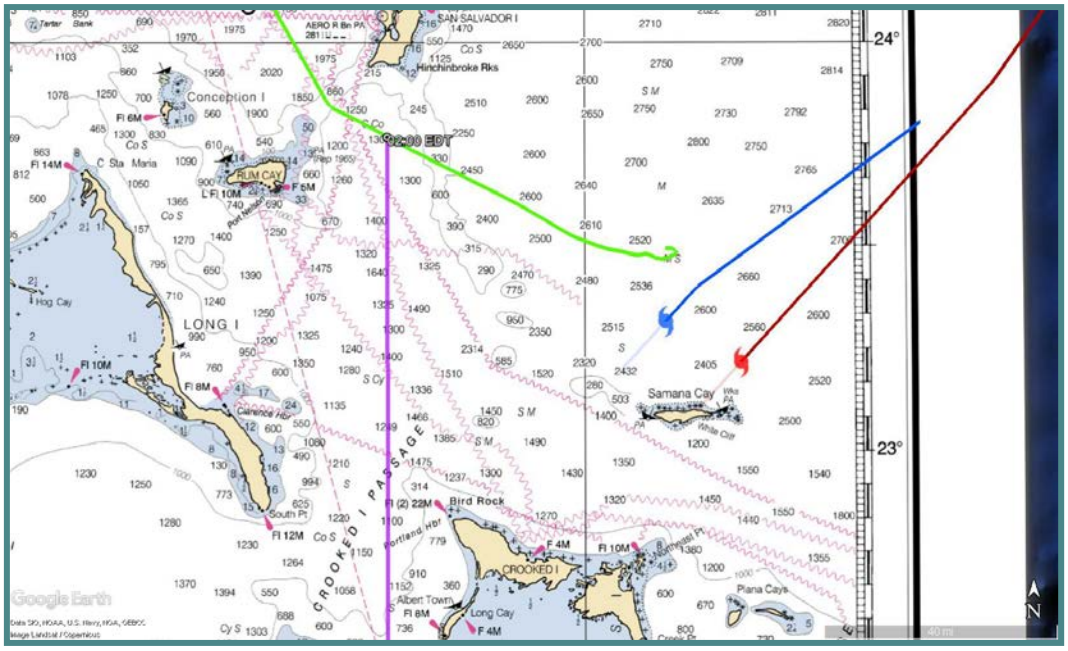


Figure AK – BVS screenshot showing Joaquin forecast center position, storm wind fields, sea-level pressure, surface wind, and significant wave height valid for 0200 EDT on October 1, 2015, contained in main BVS weather file emailed to *El Faro* about 1700 EDT on September 30, 2015.

[35] At approximately 11:45 pm EDT on September 30, 2015, the second mate[19] relieved the third mate and assumed the bridge watch. At this time, the Vessel had not yet passed San Salvador Island and had not yet made the planned course change to 116°. As part of the watch transfer process, the second mate reviewed the latest weather information and Vessel/storm track plots. Both officers concluded that the current navigation plan had become less than optimal and a safer navigation plan would be to turn due south at 2:00 am EDT and travel through the Crooked Island Passage. This would in turn connect the Vessel to the Old Bahama Channel route; an alternate route to San Juan that runs along the south side of the Bahama Islands chain. Such route would require steaming along a slightly greater distance, but would put the wind and seas of *JOAQUIN* in a more favorable "following" direction. Perhaps more importantly, the southerly course coupled with the Vessel's considerably greater speed than that of the storm would result in approximately 15 additional miles of separation between the Vessel and *JOAQUIN* every hour.

[36] Accordingly, the second mate prepared the new route waypoints and plotted the alternate track through Crooked Island Passage commencing with a course change to the south at 2:00 am EDT on October 1, 2015. This was done with the anticipation that the captain would likely come up to the bridge by that time. The magenta line in the illustration below shows the alternate route planned by the second mate -- the intersection of the magenta line with the bottom of the illustration represents the position the Vessel could have achieved by 6:00 am EDT. The light green line in the illustration depicts the Vessel's actual track until it lost propulsion shortly after 6:00 am EDT on October 1 and again, the blue and red lines show, respectively, the forecast and best paths of *JOAQUIN* to approximately 6:00 am EDT.



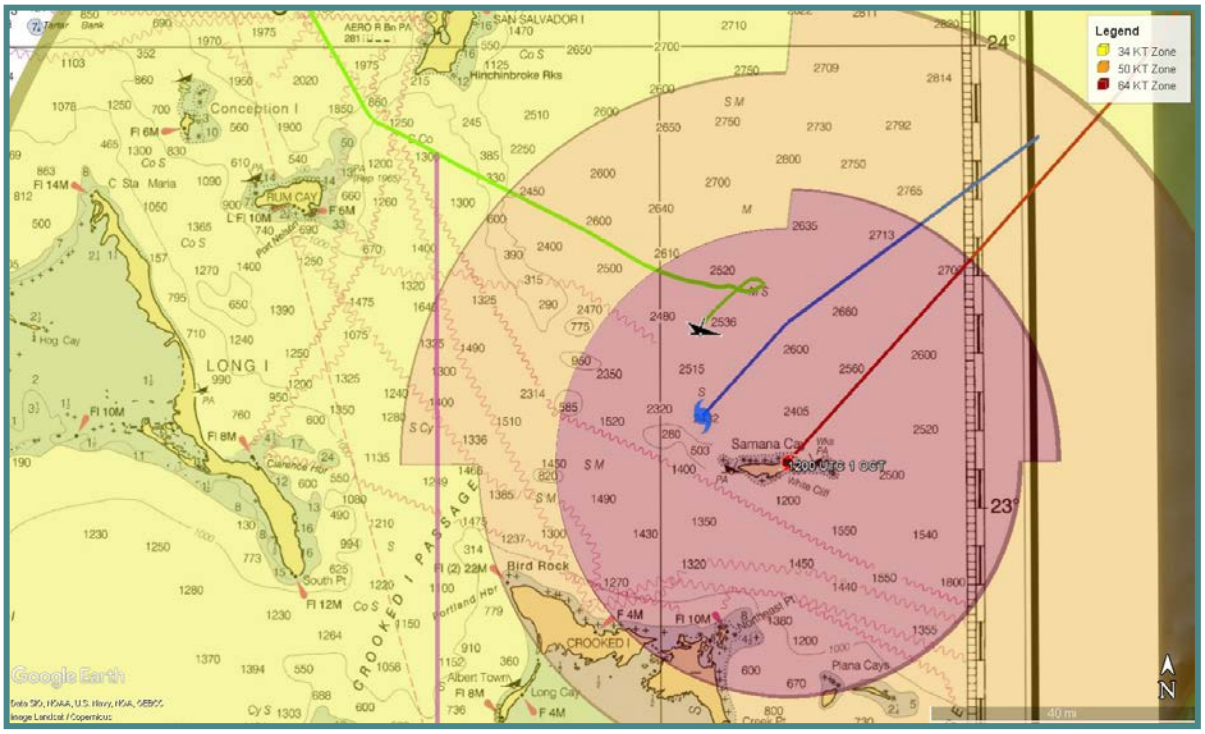
19 In the US Merchant Marine, a ship's second mate is typically its navigation officer, responsible for navigation planning and plotting, records, equipment, supplies, maintenance of charts and publications, etc.

[37] As the Vessel began to pass abeam of San Salvador Island, the second mate concluded that the planned course change to 116° was not the path the Vessel should be on under the prevailing circumstances. At 1:20 am EDT on October 1, 2015, she telephoned the captain in his stateroom to advise that the planned course change "*isn't looking good right now*" and proposed altering course to take the southerly route through Crooked Island Passage. However, the captain's response and instructions at that time were to stay with the original navigation plan and make the course change to 116°. This decision appears to have been the product of a perception by the captain, based upon the previously referenced BVS information that was later found to be inaccurate, that the Vessel would be south of the storm's center and in its navigable semi-circle.

[38] At approximately 3:15 am EDT, the second mate observed that wind speed had now increased to 50 knots and that "*we're gettin' into it now*." The building seas were causing unsecured objects to fly around the bridge and it was becoming increasingly difficult to steer the Vessel and maintain the 116° course. Thereafter, the situation deteriorated rather quickly. As the Vessel drew even nearer to the storm center, the winds and seas increased dramatically. As confirmed by the VDR transcript, the Vessel began taking on water in cargo hold number 3 through a scuttle opening in its main deck. Then, as a result of the water ingress and strong winds, the Vessel began to "list" (lean over sideways) to starboard. The Vessel's crew endeavored to address the flooding and correct the list by changing course to port (to put the wind on the starboard side) and by transferring ballast. However, the Vessel ultimately lost its main propulsion plant shortly thereafter at approximately 6:15 am EDT. With no propulsive power, the Vessel fell to the mercy of the hurricane-force winds and accompanying huge waves of a Category 3 cyclonic system, causing it to founder and sink at approximately 7:39 am EDT.

[39] Under the circumstances prevailing at the time, it is concluded that the captain committed an error in navigation by not reviewing the 11:05 pm EDT Sat-C data of September 30, 2015 that the third mate advised him of, and by not approving and implementing the second mate's proposed plan of altering course at 2:00 am EDT and proceeding southward through Crooked Island Passage. The illustration on the following page is a chart reproduced from the NTSB Meteorological Group Report that shows various wind strength fields as they actually existed at 8:00 am EDT on October 1, 2015. It has been overlaid with the various positions/tracks of the Vessel and *JOAQUIN* as previously described. As this image conclusively demonstrates, the Vessel would have never even encountered winds of 50 knots had it made the southerly course change at 2:00 am EDT. Moreover, the wind/seas that it would have encountered would have been from astern in a "following" direction and ever-decreasing as the Vessel gained more separation from the storm every hour. As such, it appears more likely than not that the Vessel would have avoided the devastating effects of close encounter with *JOAQUIN*'s center had it made a timely diversion to the south. Nonetheless, it has been previously noted that the captain's perception of where the storm was located and how it was forecast to move may have been

based upon earlier BVS data, which information ultimately proved to be noticeably different from the actual storm positions/track.



Conclusions

[40] The following conclusions and/or opinions are consistent with the report text above and all are stated with a reasonable degree of professional certainty:

- The Vessel was fit for its intended service. It had been issued and maintained a current USCG Certificate of Inspection confirming regular inspections and verified compliance with all statutory requirements for a cargo ship of its type and size on ocean routes. Additionally, the Vessel was regularly surveyed by ABS and continuously certified as being fully compliant with all applicable construction and operation rules. Finally, the Vessel was properly outfitted with all electronic data reception equipment required for its GMDSS, in full compliance with applicable regulations.
- The captain's decision to depart from the Port of Jacksonville at 8:15 pm EDT on the evening of September 29, 2015 is considered reasonable. At such time, *JOAQUIN* was a tropical depression and, although forecast to strengthen into a hurricane, its forecast track included a pronounced recurve to the north-northwest and away from the track that the Vessel would be following. Moreover, the Vessel's captain had multiple route options available both north and south of the Bahamas chain with regard to the track the Vessel would ultimately follow to San Juan.
- The captain's decision to change course at approximately 6:25 am EDT on September 30, 2015 and continue on a more south-southeasterly track to allow for more distance between the Vessel and the developing storm is

considered reasonable. Per the available forecast information at the time, such plan would have caused the Vessel to pass approximately 65 miles to the south of a storm whose hurricane force winds had a relatively small radius of only 35 miles from its center. Furthermore, the Vessel would be passing through the navigable semi-circle of a storm that was still forecast to move in a pronounced recurve to the north-northwest and further away from the track that the Vessel would be following.

- The captain's decision to alter course a second time at approximately 7:05 pm EDT on September 30, 2015 to achieve even greater separation between the Vessel and *JOAQUIN* is considered reasonable. Per the available forecast information at the time, such plan would have caused the Vessel to pass on the "back" side of the storm system and in its navigable semi-circle, while also remaining well outside the radius of hurricane force winds.
- However, by not reviewing the 11:05 pm EDT Sat-C data of September 30, 2015 that the third mate advised him of, and by not approving and implementing the second mate's proposed plan of altering course at 2:00 am EDT on October 1, 2015 to proceed southward through Crooked Island Passage, the captain committed an error in navigation. It appears that the captain had a different perception of *JOAQUIN*'s positions/track, and the juxtaposition of the Vessel relative to them, as compared to actual circumstances. Regardless, it appears more likely than not that the Vessel would have avoided the devastating effects of close encounter with *JOAQUIN*'s center had it made the timely diversion to the south proposed by the second mate.

Sincerely yours,

Captain Richard DiNapoli
Principal Consultant

APPENDIX A

C.V. of CAPTAIN RICHARD DINAPOLI

CAPTAIN RICHARD DINAPOLI

Principal Consultant for Marine Transportation Operations,
Marine Construction Contracts and Marine Construction Management

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PROFESSIONAL EXPERIENCE

1991 – present FISHER MARITIME CONSULTING GROUP

A former merchant vessel master and shipping company executive, Captain DiNapoli is a graduate of the United States Merchant Marine Academy, and holds a Coast Guard-issued license as Master and First-Class Pilot for vessels of any size. At Fisher Maritime for over 26 years, he provides specialized services in marine transportation operations, marine construction contracts, marine construction management, claim analyses and litigation support. He has extensive first-hand knowledge of marine transportation operations in ocean, coastal and inland venues, as well as shore-based marine terminal and longshoring operations, acquired through senior-level supervision of same in both seagoing and shoreside management positions. In particular, he has had multiple first-hand experiences with the presence of hurricanes in way of vessel tracks at sea. On the basis of his training and experience, he is a recognized expert in marine transportation operations, including nautical sciences such as navigation, piloting, seamanship, shiphandling and anchoring, rules of the road, meteorology, vessel stability, cargo handling, etc.

Captain DiNapoli also has considerable experience with, and is a recognized expert in, the myriad regulations applicable to marine transportation and marine construction operations of authoritative agencies such as the Coast Guard, American Bureau of Shipping, OSHA, etc. and customary industry practices for proper compliance with such regulations. With regard to marine construction and contracts, he has substantial first-hand knowledge of marine construction, conversion and repair practices acquired through the supervision and management of numerous vessel design, construction, conversion and/or repair projects, including the development, negotiation and administration of contracts for same, and is a recognized expert in marine construction contracts and marine construction practices.

Captain DiNapoli is regularly engaged in the development and support of client positions associated with marine transportation operations, contract and construction matters. In various areas of marine operations, he has prepared and presented forensic analyses in connection with maritime claims involving bulk carriers, petroleum tankers, roll on/roll off vessels, cargo vessels, passenger vessels, oceanographic research vessels, tugboats and towboats, petroleum and bulk products barges, oil-drilling rigs, crane and dredge barges, offshore supply vessels, ferries, commercial fishing vessels, oil spill response vessels and recreational boating craft from personal watercraft (jet skis) to megayachts. In connection with marine contracts and construction, his senior-level management background included daily supervision and management of numerous vessel design, construction and/or

conversion projects and the successful administration of related contracts. During his 40+ years within the maritime industry, he has been responsible for the preparation, administration and/or analysis of marine construction contracts that total in excess of $2.5 billion and has served as senior analyst of more than 35 major claims by and between shipyards and ship owners.

As a maritime industry expert, Captain DiNapoli has been retained in connection with over 300 matters pursued or pending in federal and state courts, as well as American Arbitration Association venues in Maine, Massachusetts, Connecticut, Rhode Island, New York, New Jersey, Pennsylvania, Maryland, Delaware, Minnesota, Wisconsin, Michigan, Indiana, Illinois, West Virginia, Ohio, Kentucky, Tennessee, Arkansas, Virginia, Florida, Alabama, Mississippi, Louisiana, Texas, Arizona, California and Washington. He has also been engaged to support litigation proceedings in the courts of various Canadian provinces and the United Kingdom.

PRIOR PROFESSIONAL EXPERIENCE

1985 - 1991 Ocean Signals, Inc.
Vice President/General Manager

Ocean Signals was a management consulting company that organized a diverse assortment of expertise to address specialized needs of corporations in the areas of operations, engineering, finance and administration. The primary responsibilities of the Vice President/General Manager encompassed the implementation of the corporation's business plan, which included development of new markets as well as maintenance of existing accounts. As the primary client interface, he was responsible for the direct supervision of all ongoing projects. Projects supervised included:

- revision of corporate policies/procedures and line operations/engineering plans for an oceangoing, liner service company
- development of the curriculum for a tug and barge handling course for a major state maritime academy
- provision of case support research and expert testimony for a number of law firms handling marine-related claims and contract disputes
- preparation of bids in response to government "Requests For Proposals" involving multi-vessel charters, for an oceangoing steamship company
- restructuring of management and administrative functions of a marine insurance brokerage firm

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1984 to 1990 Standard Marine Services, Inc.
Master and Pilot

Served as Master aboard tugboats of 1800 to 4000 horsepower providing handling and transportation of various types of barges on ocean, coastwise and inland routes as well as ship docking and pilot services. Responsibilities included supervision of all navigation and

barge handling (including tank barges of over 100,000 barrel capacity) as well as participation in ship docking and pilot operations.

1988 to 1989 Standard Marine Services, Inc.
Marine Transportation Manager

Managed marine transportation operations with responsibility for the efficient and profitable deployment of its tugboats and petroleum product barges. Directly supervised all phases of marine operations including sales, rate structures, contract and vessel charter negotiations, customer relations, labor relations, scheduling, invoicing, vessel management and communications.

1982 to 1984 Prudential Lines, Inc.
Director of Operations/Planning

Served as operations/planning director for this shipping company that provided scheduled container vessel service to various Mediterranean ports from four terminals situated along the U.S. East Coast and associated road/rail intermodal links. In addition to daily management duties in the areas of operations, engineering, maintenance/repair, personnel and regulatory agency issues, managed corporate special projects including Prudential's participation in a $360 million Hospital Ship conversion project and the conversion/charter of cargo vessels to the Military Sealift Command. Responsibilities included bid and contract document preparation, contract administration (including dispute resolution), project fiscal control, project engineering control, subcontractor management and accountability for performance.

1978 to 1982 Ship Analytics, Inc.
Program Director

Began as a part-time consultant during periods of leave from active seagoing employment and later became the full time Program Director for this company specializing in marine transportation research and training services via state of the art marine simulators. Developed and managed operational research and training programs for military, government and commercial ship operators entailing detailed simulation of container, tanker, LNG, tug/barge and specialty vessels, including submarines. Served as on-site manager and head shiphandling instructor for a federal ship simulator facility located at the US Merchant Marine Academy.

1975 to 1980 Mobil Oil Corporation
Master and Pilot

Served as Master of coastwise and inland oil tankers and tugboats engaged in the handling and transportation of oil barges.

1972 to 1975 Mobil Oil Corporation
Junior Officer

Served as Third Officer aboard worldwide ocean-going oil tankers and as Able Seaman, then Second Officer, First Officer and Pilot aboard coastwise and inland oil tankers and tugboats engaged in the handling and transportation of oil barges.

EDUCATION

1972 - United States Merchant Marine Academy
Kings Point, NY
Bachelor of Science