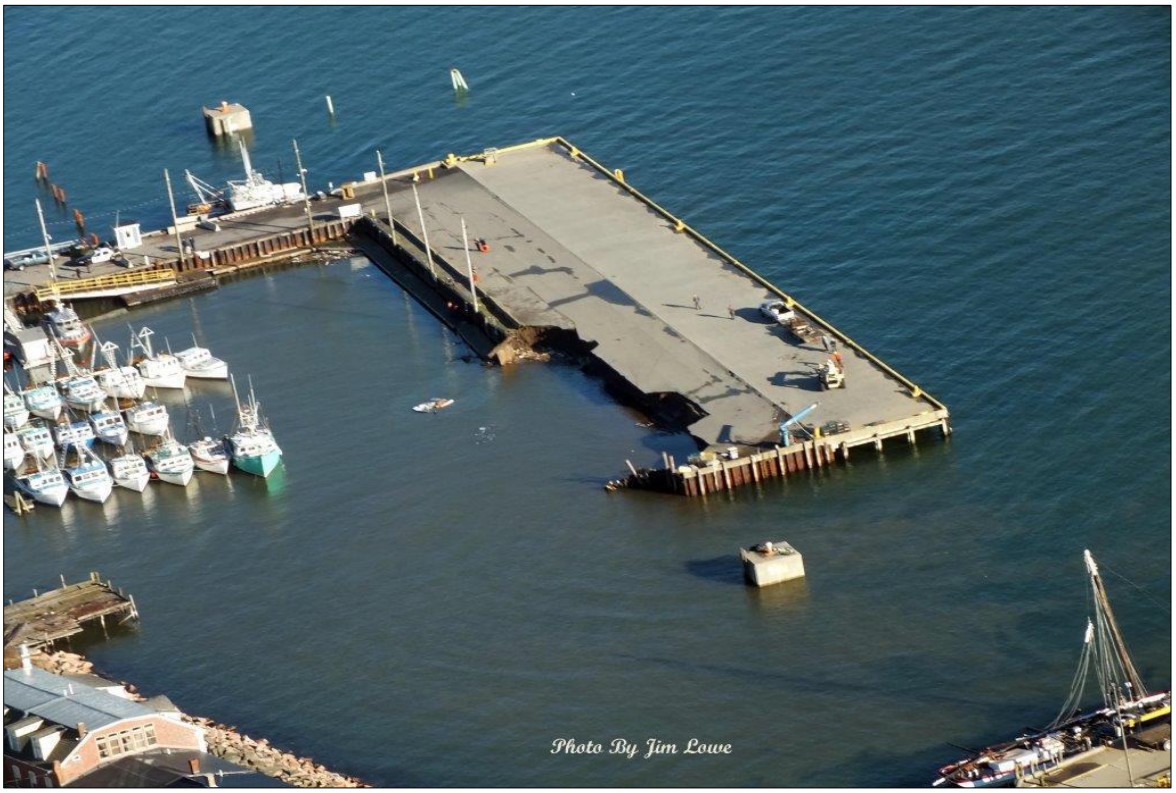
National Transportation Safety Board

Marine Accident Brief

Breakwater Pier Collapse in Eastport, Maine

Accident no.	DCA15LM006
Vessel names	*Ada C. Lore, Double Trouble 2, Medric II*
Accident type	Pier collapse and subsequent damage to moored vessels
Location	Eastport, Maine
Date, time	December 4, 2014 0158 eastern standard time (coordinated universal time − 5 hours)
Injuries	None
Damage	*Ada C. Lore*, $480,000; *Double Trouble 2*, $110,000; *Medric II*, $120,000
Environmental damage	Slight oil sheen
Weather	Low tide, clear, calm
Waterway information	Cobscook Bay, at the mouth of the Bay of Fundy, west of Deer Island and Campobello Island, Canada

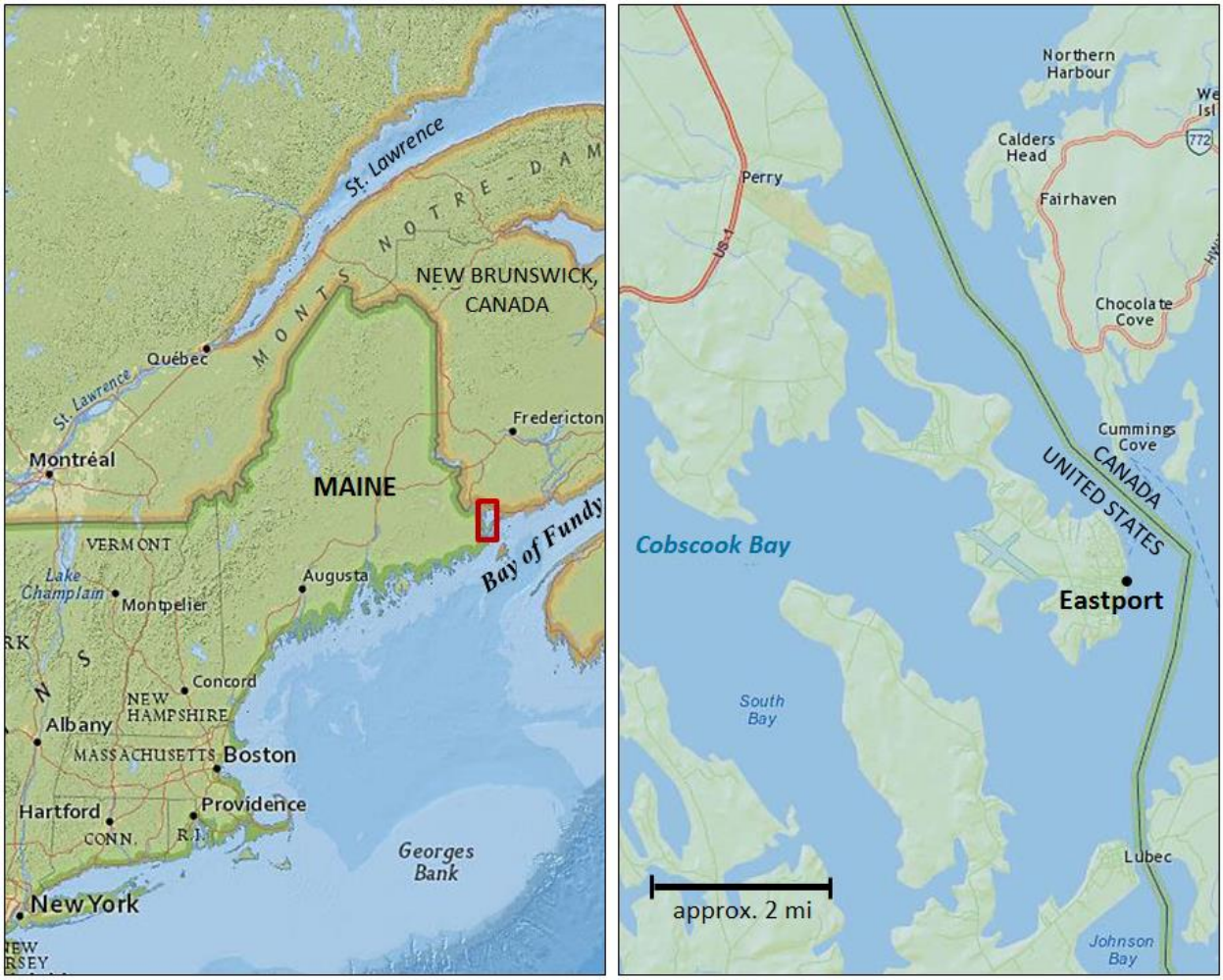
A 200-foot section on the western side of the Eastport breakwater pier in Eastport, Maine, collapsed about 0200 local time on December 4, 2014, damaging several vessels that were moored alongside. No injuries and minor pollution were reported.



Aerial photo of the Eastport, Maine, breakwater pier after collapse. (Photo by Jim Lowe)

The Eastport breakwater pier, the easternmost port facility in the United States, is located at the mouth of the Bay of Fundy and is owned by the city of Eastport and operated by the Eastport Port Authority. The pier is L-shaped, with one leg perpendicular to the shoreline and the outer leg parallel. Approach depths to the breakwater are over 100 feet, and the mean low water depth is 42 feet.

The pier has berthing capability for vessels up to 700 feet in length. Located in the downtown area of Eastport, the pier offers cruise ships a direct docking near all of Eastport's commercial, cultural, historic, and recreational attractions. The breakwater provides a protected docking area between the breakwater and the shore for commercial fishermen and recreational boaters. The Eastport Port Authority, US Customs and Border Patrol, and US Coast Guard maintain facilities at the base of the breakwater pier. Two Eastport Coast Guard station response vessels are docked inside the breakwater.

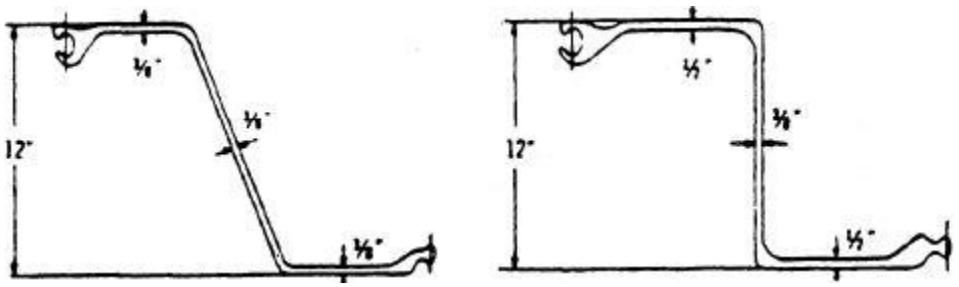


Eastport, Maine, in the far northeastern United States, location of the breakwater pier collapse. (Background by National Geographic Mapmaker Interactive)

Pier Construction

The original 420-foot by 50-foot section of the breakwater pier was built by the US Army Corps of Engineers in 1962 with a 20-year life expectancy. It was composed of an asphalt surface over a stone base surrounded by a steel sheet pile enclosure and supported by wooden pilings. Structural sections of Z-27 and Z-38 steel sheet piling in a vertical interlocking system created the continuous exterior wall. Each sheet pile section is shaped roughly like a horizontally

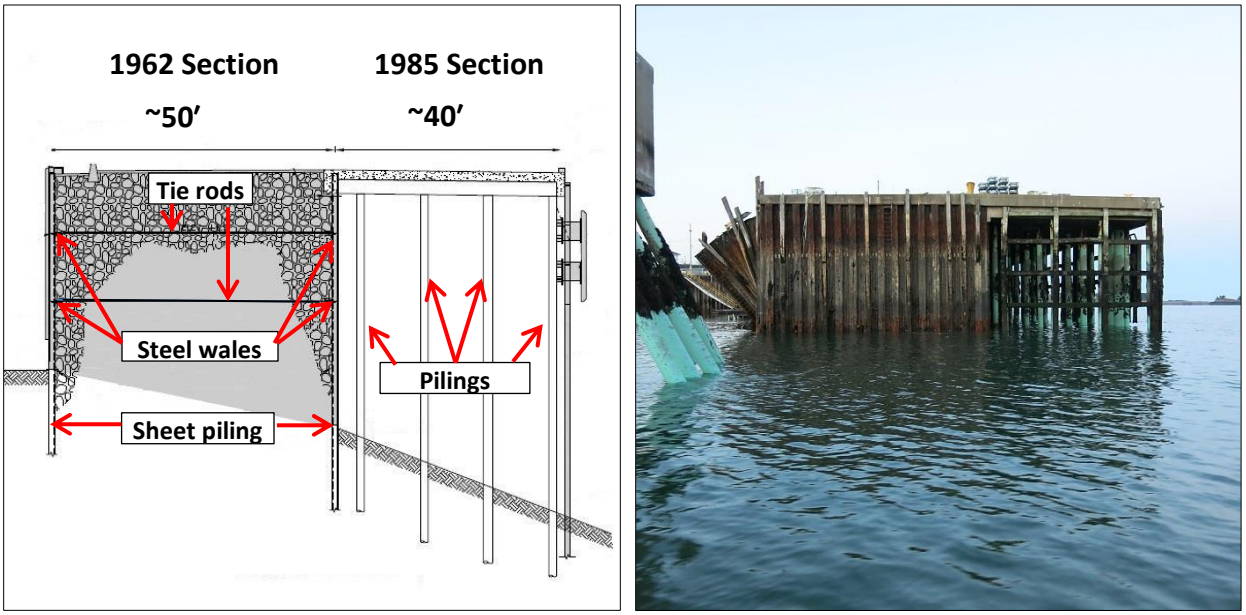
stretched letter Z as seen from above, and the number after the letter Z designates its dimensions and the weight in pounds per square foot of piling.



Typical Z-27 and Z-38 steel piling. (Diagram by U.S. Steel, courtesy of Childs Engineering Corp.)

The sections of sheet piling were supported by two rows of 2.75-inch-diameter horizontal tie rods and turnbuckles spaced 6 feet apart and secured with steel wales. Steel wales are horizontal constructional members used for bracing vertical members at each end. The wales used in the Eastport breakwater were 12-inch H-beams with a web thickness of 1.5 inches.

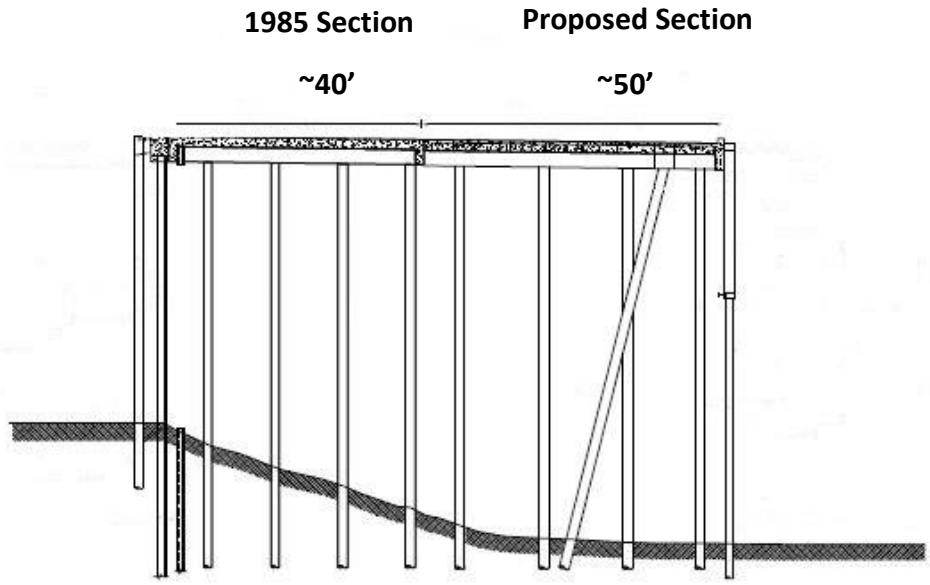
In 1985, a 410-foot x 40-foot section was added alongside the seaward side of the original breakwater pier to allow larger vessels to use the greater water depth at the new dock's offshore face. This concrete-topped pier was constructed with steel and concrete pilings driven into the ocean floor. The older breakwater provided stability and lateral bracing from Eastport's 27-foot tides and weather.



Cross section of the Eastport breakwater pier before the collapse (left) and actual pier after the collapse (right). (Drawing by Childs Engineering Corp.)

Several repairs were carried out on the original section. A vessel damaged a section of the eastern side of the breakwater while docking in 1982, and a barge broke loose from an anchorage and rammed the northern corner in 1985. In 1994, a 20-foot section of the western side of the breakwater collapsed and was repaired. In 2012, a section of the structure failed on the north side. Several inspections were conducted of the underwater structure, revealing significant deterioration of the sheet piling.

Due to the breakwater's age and deteriorated state, in August 2013, the Maine Department of Transportation (Maine DOT) engaged Childs Engineering Corp. from Bellingham, Massachusetts, to design a replacement structure for the original pier. Reconstruction plans included demolishing the original section and replacing it with a new 400-foot by 50-foot piece to be built on concrete-filled steel pilings located outside the 1985 section. A single layer of sheet pile was designed to form a new breakwater inside the 1985 section. Relocating the pier would enlarge the inner part of the harbor by 20,000 square feet. The construction project called for the use of composite materials in place of steel in some parts to mitigate deterioration. The cost of the reconstruction project was estimated at $14.95 million, to be funded by the US Government, state of Maine, and Eastport Port Authority.



Cross-section of proposed pier design after demolition of 1962 breakwater. (Drawing by Childs Engineering Corp.)

Pier Collapse

The collapse occurred on the original 1962 structure at the southern end on the west face at low tide on a calm, clear night. About 20 vessels were moored to floating docks alongside the pier, and several broke free from their moorings after the section collapsed and were recovered. Three vessels docked closest to the collapsed section sustained substantial damage. A Ford Ranger pickup truck parked on the pier fell onto one of the boats and then into the water and was partially submerged.

Just before 0200 on the morning of the collapse, a caretaker living on board the schooner *Ada C. Lore*, which was docked directly to the west of the affected section of the breakwater, was awakened by noises coming from the breakwater pier. He went up on deck to investigate and noticed the inner portion of the breakwater was bowing outward toward his vessel. He went below deck to retrieve his pet dog and a few belongings before departing the vessel. When he came back on deck, he heard a loud crash as the inner portion of the breakwater pier collapsed onto the *Ada C. Lore* and other moored vessels.

As a result of debris falling onto the vessel, he fell backwards and injured his ankle. He noticed the port quarter of the vessel was covered with rubble. A power pole had fallen onto the *Ada C. Lore*, and the vessel was listing severely to port. When the owner arrived, he and others began clearing debris from the vessel, and the vessel was then moved to another pier across the

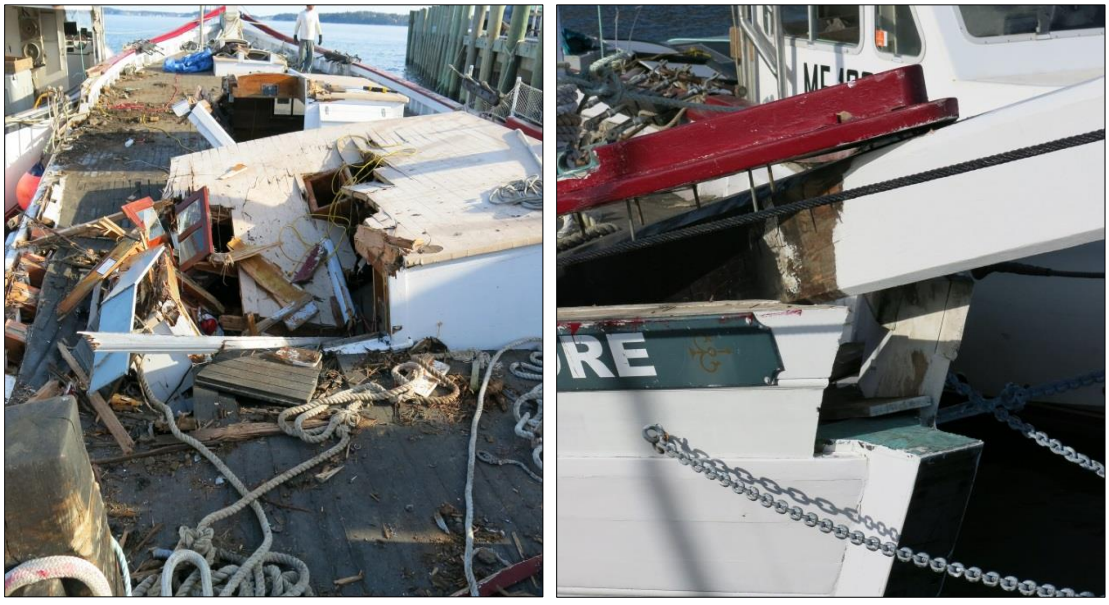
harbor. The caretaker was taken by ambulance to a hospital for evaluation. He received an x-ray and was advised he had no fractures and did not require further medical treatment.

The Eastport Port Authority's security camera system captured the event from four locations. Power poles over the affected area slowly began leaning away from the pier as the sheet piles peeled away and then suddenly fell onto the moored boats when the structure gave way. Power poles, steel sheet piles, debris, and solid fill landed on the boats and fell into the water. Several vessels broke free from the pier.

Due to the debris in the water, US Coast Guard Station Eastport small boats that were docked inside the breakwater pier were unable to respond to calls until the waterway was cleared the following day. Coast Guard Station Jonesport assumed temporary duty during this time.

Affected Vessels

The *Ada C. Lore* was a wooden schooner used for whale watching tours. At the time of the collapse, it was secured to a floating dock attached to the pier port side-to. A postaccident survey found extensive damage. The wooden fore and main masts, gaffs, and associated standing rigging were torn off and damaged beyond repair; about 50 feet of the aft port quarter rail and associated stanchions were torn off the side of the vessel; the trunk house and all associated structural components were crushed about 4 feet into the deck; the aft deckhouse interior and all electrical and engine panels were destroyed; and the bowsprit was lifted out of its chocks. Two holes were found on the main deck, and the main deck was reported to be leaking significantly. The vessel was declared a total constructive loss. The vessel was sold with the intention of repairing and bringing it back into passenger service.



The *Ada C. Lore* after the pier collapse. Left photo shows crushed deckhouse. Photo at right shows bowsprit lifted out of its chocks.

The *Double Trouble 2* was a privately owned 45-foot-long fiberglass fishing vessel. As a result of the pier collapse, it sank to the windows of the shelter deck and the engine room flooded. The vessel was recovered, revealing extensive damage. The A-frame used for scallop dragging was bent and damaged beyond repair, and the deck below it was fractured. The aft starboard quarter of the hull was significantly damaged; the cap rail was torn off from the deckhouse to the stern, and the hull was split at the stern. The trap hauling system was torn off

the starboard side, the deckhouse was fractured and two windows were broken, and the door was torn off. The *Double Trouble 2* was also declared a total constructive loss.

Stern of private fishing vessel *Double Trouble 2* after the pier collapse.

The *Medric II* was a multipurpose work boat constructed of high-density polyethylene (HDPE) that had been tied up to the floating dock alongside the bulkhead. The vessel was used for tending salmon farm pens, transporting cargo, surveying, and transporting local pilots to and from vessels. When the pier collapsed, the *Medric II* was hit by the pickup truck, and large sections of sheet pile, stone, gravel, and a light pole fell across the wheelhouse.

The *Medric II* was completely submerged but was recovered later that morning and taken ashore. An inspection revealed a 12-inch hole through the bottom of the hull from a power pole, more than a dozen fractures in the bottom, a broken pontoon, and a dislodged transom. The vessel was observed to be distinctly hogged (curved upward) in the center, which indicated a major structural failure. The wheelhouse was also completely destroyed. The two outboard engines were hit by the falling truck and debris and then forced to the bottom where they lay submerged for hours. Gasoline from the tanks below deck leaked out and damaged the Styrofoam flotation located inside the hull. This vessel was declared a total constructive loss.

The *Medric II* submerged the morning of the collapse (left) and recovered on blocks (right). (Left photo by Coast Guard)

After the incident, Maine DOT asked Childs Engineering Corp. to assess the damage to the pier and determine the potential for further collapse. The firm's survey stated, "Tie rods and wales associated with bollards on the offshore face were observed to have separated at the sheet pile by failure of the connecting bolts," but at that time, the immediate area appeared to be stable from further collapse. The company advised, however, that due to the general condition of the structure, the pier should not be used. The engineering firm concluded, "The collapse was a result of failure of the lateral restraint system which consists of 2 levels of tie rods arranged to resist lateral earth pressure. The exact failure mode could not be determined." Review of previous inspections indicated the steel sheet pile structure had experienced significant structural deterioration since its original construction.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the collapse of the Eastport Port Authority breakwater pier was the failure of the lateral restraint system due to the structure's long-term deterioration.

Vessel Particulars

Vessel	*Ada C. Lore*	*Double Trouble 2*	*Medric II*
Owner/operator	Eastport Windjammers	Brent Griffin	Nordic Delight Seafood
Port of registry	Maine	Maine	Maine
Flag	US	US	US
Type	Small passenger vessel	Commercial fishing vessel	Pilot boat
Year built	1923	2001	1996
Official number (US)	222897	ME14KHL	9428ZME
IMO number	N/A	N/A	N/A
Construction	Wood	Fiberglass	HDPE
Length	77 ft (23.5 m)	45 ft (13.7 m)	48 ft (14.6 m)
Draft	6 ft (1.8 m)	N/A	2 ft (0.6 m)
Beam/width	22.5 ft (6.9 m)	N/A	16 ft (4.9 m)
Tonnage	59 gross tons	N/A	4.9 gross tons
Engine power, manufacturer	Diesel	Diesel	Two 135 hp Honda gasoline engines
Persons on board	1	0	0

NTSB investigators worked closely with our counterparts from US Coast Guard Sector Northern New England throughout this investigation.

For more details about this accident, visit www.ntsb.gov and search for NTSB accident ID DCA15LM006.

Adopted: June 12, 2015