

# Unmanned Autonomous Aviation Systems as a Post-Disaster, Human-Capital Force Multiplier

Sector Delaware Bay's partnership efforts

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Despite an evolving and robust offshore unmanned aviation systems (UAS) program used by Coast Guard cutters in the deep maritime environment, the Coast Guard has struggled with a clear use-case to move into the UAS arena for operations ashore.

Emerging technologies, new Federal Aviation Administration (FAA) regulations, limited budgets and personnel, cyber security, and federal privacy laws are all challenges to developing a national UAS program when operating within the continental United States. The Coast Guard is unique among services. It is a federal agency that operates with national level oversight of regulations but also operates in lock step with emergency management elements at the lowest local level. These relationships with local governments make the

Coast Guard a greatly effective response agency but also make applying a "broad brush" approach to emerging programs and technology difficult to enact to meet such a diverse set of needs across the hemisphere.

Partnerships and synergy of mission have been the policy of the Coast Guard with regard to achieving common goals with local, state, and even other federal agencies since the Coast Guard's inception.

With respect to UAS innovations and technology within the Port of Philadelphia, Coast Guard Sector Delaware Bay has been documenting industry counter-UAS capabilities through the Area Maritime Security Committee. This is in addition to participating in government led UAS initiatives that may enhance sector emergency response and that of our port partners. The primary focus of this article will be from this perspective.

Prior to discussing any of our UAS experiences, it is imperative to understand the general operating environment that encompasses Sector Delaware Bay. Within the sector's area of responsibility (AOR) are three states, two Environmental Protection Agency and Federal Emergency Management Agency regions, and 18 counties. The Delaware River and Bay are home to the largest importers of fruit, juice, paper, and cocoa beans. It is the largest freshwater port in the world, as well as the largest liquefied petroleum gas exporter on the East Coast. The refinery capacity within the port ensures that, on any given day, there will be between 4 million and 9 million barrels of crude oil in transit or at anchor and 90,000 barrels arriving in port by rail each day. These industries, and many others,



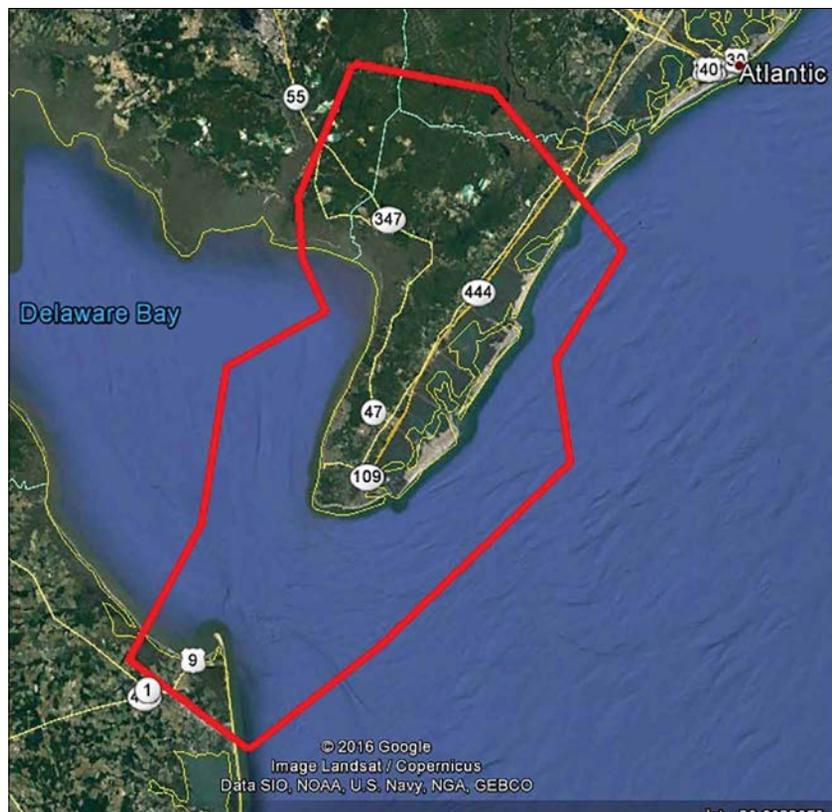
The Hx8 XXL is an American-made unmanned aviation system, used in a Defense Logistics Agency operation to carry supplies to the Coast Guard Cutter *Lawrence O. Lawson*. It can carry payloads of up to 70 pounds for up to 5 miles. Coast Guard photo by CWO4 Todd Wardwell

have created and sustained 135,000 jobs while raising more than \$78 billion a year in this tristate area.<sup>1</sup> There are more than a quarter of a million recreational boaters in the AOR coexisting with critical natural resource habitats and the largest scalloping grounds in North America. By a 2019 estimate, a mid-river port closure would cost more than \$1,500 U.S. dollars (USD) a second in real capital lost just within the directly affected maritime industries. Secondary and tertiary industries indirectly affected by a daily port shut down could post monetary losses closer to \$4,000 USD a second. It is with this in mind, that it becomes obvious that unmanned autonomous-aviation systems can become a major post-disaster human capital force multiplier.

The key to operating in an environmentally, industrially, and economically unforgiving AOR is partnerships at all levels of government, private sector organizations, and community/volunteer groups. Setting up a unified command structure for large-scale emergency management issues in the Delaware Bay AOR is not a nicety, but a necessity and requires these partnerships. It was through these partnerships that members of Sector Delaware Bay Incident Management Division learned of regional efforts by the private sector and local governments to build up UAS research efforts within New Jersey's Cape May County. The county was granted a waiver by the FAA to conduct unmanned test flights over much of the county, as well as adjacent areas of the Atlantic Ocean and Delaware Bay. (See map)

The FAA waiver, known as a Certificate of Authorization (COA), is only issued by the FAA for specialized purposes. Cape May's COA allows for testing and developing high-altitude, long-range flights with unmanned aerial vehicles (UAV) of more than 55 pounds at altitudes up to 7,000 feet. UAS's under 55 pounds can fly using this COA but are additionally licensed under the FAA Part 107 regulations.

After attending a UAS innovation event in Cape May, the sector networked with American Aerospace Technologies, Inc. (AATI). The small company is working with Cape May County to use the existing COA to



In conjunction with Cape May County, New Jersey, American Aerospace Technologies, Inc., has been granted a certificate of authorization (COA) to operate a commercial unmanned aircraft in the area designated by the red lines. A COA is a waiver issued by the Federal Aviation Administration authorizing operation of unmanned aviation in a designated area. Graphic courtesy of American Aerospace Technologies, Inc., and Google Maps

spearhead public and private partnerships with respect to autonomous vehicles. The company showed great interest in adapting current and future technologies to better facilitate emergency management capabilities. These efforts quickly evolved to include post-hurricane response, oil and hazmat spill response, and a real-time picture of port safety.

### What is a Femtocell?

A Femtocell is essentially a small cell site in the sky that can provide 4G cell phone and internet coverage to areas where traditional service is not available, or no longer available, due to ongoing incidents.

### Public-Private Partnerships

AATI had been doing considerable outreach about conducting UAS demonstrations. In May 2017, it conducted a functional exercise to test a post-hurricane response sortie in an environment where communications were down. The UAS, an RS-20 with an average flight time of 16 hours, carried a small Verizon

wireless airborne LTE operations "femtocell" modem on board.

There were two objectives for this flight.

Objective 1: Provide wireless communications for first responders in a simulated post-disaster,

communications-denied environment through the UAS, connecting them with Cape May County Office of Emergency Management (OEM) and the New Jersey State Police Regional Incident Operations Center (RIOC).

Objective 2: Provide near real-time, map-based imagery to county OEM and the RIOC from the UAS.

The New Jersey Department of Transportation, State Police, Cape May County and New Jersey offices of Emergency Management, Verizon Communications, and Coast Guard Sector Delaware Bay all participated in the drill. During the exercise, high-resolution, map-based imagery from the overflight was simultaneously broadcast via secure weblink to Philadelphia; Trenton, New Jersey; and the Cape May County Emergency Operations Center. It was also received at a command van located at the Woodbine, New Jersey, airport where the flight crew was located. The bandwidth and coverage provided by the modem on board the RS-20, allowed for use of the UAS's imagery and data by limitless ground locations, and the lag time between collection and distribution of the imagery was only a few seconds, meaning the UAV never needed to land to upload the data and could stay on station.

Anyone who has ever done a "hot wash" after a major disaster or emergency management drill will note that communications was one of the problems during the event. In most post-hurricane areas, cell phone communications will be almost crippled due to outages in both power grids and/or cell towers. During the exercise, AATI continued to work with Verizon wireless to use a UAS as a post-hurricane replacement for simulated tower outages. Essentially the UAV would act as a 2000-foot-tall cell tower while flying. First responders were able to witness directly, on dozens of wireless devices, the transition from regional cell service-providing towers to the cellular service provided by the UAS with no drop in clarity or bandwidth.

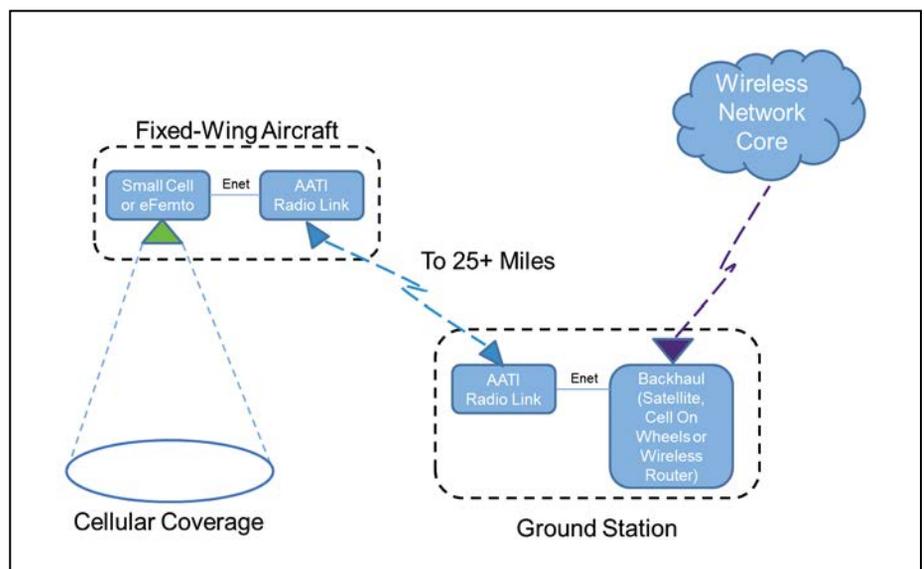
### Lessons Learned from Hurricane Irma

The conditions experienced in the Florida Keys after Hurricane Irma are well documented at this point, but there are a few important issues worth revisiting. In the initial phase of the hurricane, the primary operating picture for Coast Guard responders was in the form of satellite imagery provided by the National Oceanic and Atmospheric Administration (NOAA). This consisted of a few passes over the Keys

in a period of less than a week. The routinely encountered problems of little or no cellular service and internet coverage made getting this imagery from the incident command post in Miami to responders in the Florida Keys incredibly challenging. These issues did not improve as hurricane operations in Puerto Rico became a higher priority and the capabilities in the Keys were redeployed to those areas. In previous hurricane responses there has been an expectation of being able to access contracted private aviation assets for non-emergency missions. This was not the case in the Keys as many of the existing aviation landing strips or pads were being used for housing or not accessible due to infrastructure damage. There were simply no private contract aviation platforms readily available that could operate in those environments. This meant that finding leaking vessels, sunken boats, blocked channels, and searches for human remains had to be conducted by multi-agency teams doing in-person scouting in vehicles and vessels using week-old satellite images.

### Defense Logistics Agency (DLA) Test Flights

With lessons learned in hand, Sector Delaware Bay again attended a UAS conference in Cape May and sponsored by the Cape May County Chamber of Commerce. Coast Guard personnel gave presentations on lessons learned from Hurricane Irma and how UAS could have been deployed to assist based on previous experience with our public and private partnerships. In the audience was a contingent of personnel from the Philadelphia office of the Defense Logistics Agency (DLA). They had gone to great lengths in the previous hurricane season to procure and ship huge quantities of Meals Ready to Eat (MRE's)



During disaster response, the unmanned aviation system (UAS) acts as a substitute for a cell tower while flying. In tests, there was a transition from regional cellular service to cellular service provided by the UAS with no drop in clarity or bandwidth. Graphic courtesy of American Aerospace Technologies, Inc.

to Puerto Rico. The MREs made it down via vessel to Puerto Rico but ended up not being delivered due to wide spread failures in the marine transportation system, including port berth availability, as well as damage to cargo handling equipment. DLA representatives spent time talking with Sector Delaware Bay responders who were deployed to the hurricanes to get a better sense of what could be done in the future to get logistical supplies into the hands of those that needed them most. The consensus among all the responders was that port closures and deliveries to the “last three miles” were the most problematic for on-water logistics missions. The last three miles means that responders were unable to get critical supplies from main roads or routes into smaller side streets or towns to get the supplies to people who desperately needed them. In the case of logistics in post-hurricane Puerto Rico, there was no way to start getting supplies off the vessel. In essence, the hurricane response became a first three miles and last three miles problem. DLA wished to collaborate with AATI and Coast Guard Sector Delaware Bay to conduct a test flight with an unmanned food and water delivery from a land-to-land flight and a land-to-water flight involving a vessel.

### **Unmanned Flight Operations on the Coast Guard Cutter *Lawrence O. Lawson***

Many administrative hurdles pushed the DLA test flight back. Department of Defense (DoD) cyber security issued an edict stating all UAS operations outside of combat zones would cease until the UAS contractor could prove the UAVs had no cyber vulnerabilities created by a foreign manufacturer. At this time, AATI had brought on Skyscape Industries, a subcontractor, to handle the logistics mission with a large cargo octocopter UAV. To meet DoD cyber security requirements, the entire UAS had been created primarily in the United States, but the majority of its operating code was manually rewritten to ensure compliance and increase flight safety parameters. Skyscape’s UAS met approval and was allowed to continue. The ferry terminal in Cape May was selected as the primary launch and recovery facility. Located 2 miles away, the Rutgers Agricultural Facility in Cape May was to be the land-to-land portion of the



The Hx8 XXL unmanned aviation system is shown here, loaded and ready to fly, with over 60 pounds of Meals Ready-to-Eat, and two cases of bottled water underslung from its cargo system. This was part of a joint exercise between the crew of Coast Guard Cutter *Lawrence O. Lawson* and the Defense Logistics Agency. Coast Guard photo by CWO4 Todd Wardwell

test. For the land-to-vessel portion, the Coast Guard Cutter *Lawrence O. Lawson* was identified as a potential candidate. The *Lawson* is a 154-foot patrol boat that has no flight deck but has a dedicated hoist area that was ideal for landing or unloading a UAV.

Prior to operating in the vicinity of the cutter, the contractor wished to conduct an electronics emissions safety check to ensure that the cutter’s broadcasting/transmitting gear did not interfere with the electronic systems on board the UAV. The test was conducted by simulating a flight using a crane with straps on the dock to “hover” the UAV in front of the cutter. The cutter then switched on various radar and communication units to ensure that contact between the UAV and the monitoring pilot was not lost. This enabled the cutter to have a list of emissions safe gear that could be activated during the approach of the UAV with no loss of navigation safety.

In July 2019, AATI was ready to fly the payload after

numerous setbacks and administrative hurdles from a multitude of sources. The UAV that flew on that day in July was almost completely rebuilt, reprogrammed, and refitted from the stock airframe that AATI had started with. The Hx8 XXL took off and carried a 50-pound cargo of bottled water and MRE's from the Cape May Ferry Terminal to the Rutgers Agricultural Campus and back with no issues. Trailing the UAV up the back bay was a "chase" safety boat provided by Coast Guard Station Cape May. The UAV was checked, recharged and made ready to rendezvous with the *Lawson*. The transit to the *Lawson* was flawless and incredibly efficient using only 30 percent of the expected battery life to travel the 1.2 miles to the cutter offshore. For safety, the UAV did not land on the cutter but it dropped the cargo to the deck. A DLA member inspected the cargo to ensure no breakage and the UAV returned to the ferry terminal.

### Future Operations and Final Thoughts

DLA is looking to conduct additional testing in the future to acquire a much longer range UAS to deliver emergency response rations, though at this time the future DLA project has not yet been put up for bid. AATI has since been hired by multiple private industries to conduct long-range pipeline and infrastructure surveys nationwide. Taking what they have learned from the Cape May COA process, they are assisting other parts of the country in applying for special use UAS authorizations. AATI continues to push boundaries using UAS technologies relating to emergency management. In 2017, they proved to be an invaluable resource during a NOAA/Industry drill conducted off of Santa Barbara, California, using natural oil seeps as targets. Using UAS real-time imagery and "Drone to Map" GIS overlay software, oil-spill responders were able to deploy shoreline cleanup assessment techniques teams more than eight hours faster than previous spills. Imagery was able to find even partially hidden targets, which were geo-tagged and uploaded into Survey 123 programs and used by the teams in the field. In the years since that drill, technology has become mainstream with reduced costs.

Coast Guard Sector Delaware Bay continues to rely heavily on partner agencies through our various committees. This includes both the use of UAS for nontraditional responses and through our area maritime security committee, as well as best practices to counter the use of UAS for the purpose of port safety/security. UAS, and other unmanned vehicle systems, will become far more mainstream as the safety factors increase and the costs decrease. Under current safety regulations, or operating certificates, it can take twice as many personnel to fly an "unmanned" mission as it would to simply fly a mission via a regular aviation asset. As these programs mature and become more common, the quantity of people

involved will diminish as fast as the usefulness of the technology increases. Despite greater personnel requirements, the Standard Rate Instruction<sup>2</sup> indicates the direct cost of operating a Coast Guard HH-65 helicopter for one hour was far more expensive than 16 hours of UAS flight time with a five-person team and support vehicles. Future UAS flights will be longer, and far more multi-mission in nature with the ability to carry out several tasks at once. In this sense, UAS will be a true human-capital force multiplier, freeing up both field and command post personnel. This will occur at the same time, increasing the quality of information provided while cutting response times by hours and days. This major increase in the Coast Guard response curve is critical when responding to a major disaster, including an oil spill, as the damage to the economy and environment are quite literally quantified in seconds and minutes. ▀

### Acknowledgements:

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### About the author:

CWO4 Todd Wardwell is the very first active duty Marine Safety Specialist Response and has more than 26 years of service including six years as a marine inspector. He has responded to more than 17 Type 1 incidents, including the WTC GZ Operations, Washington Anthrax Cleanup, Shuttle Columbia Recovery, Hurricane Katrina, Deepwater Horizon, Super Storm Sandy, and Hurricane Irma. He has held the certified emergency manager (CEM) designation since 2013 and is assigned to Coast Guard Sector Delaware Bay in the Marine Environmental Response Branch.

### Endnote:

<sup>1</sup>. Delaware Bay Economic Stats: [www.portofwilmington.com/economic-impact.html](http://www.portofwilmington.com/economic-impact.html); [www.philaport.com/wp-content/uploads/2017/10/PhilaPort-2017-Brochure-Web.pdf](http://www.philaport.com/wp-content/uploads/2017/10/PhilaPort-2017-Brochure-Web.pdf); [www.southjerseyport.com/community/economic-impact/](http://www.southjerseyport.com/community/economic-impact/)

<sup>2</sup>. COMMANDANT INSTRUCTION 7310.1U Standard Rates: [https://media.defense.gov/2020/Mar/04/2002258826/-1/-1/0/CI\\_7310\\_1U.PDF](https://media.defense.gov/2020/Mar/04/2002258826/-1/-1/0/CI_7310_1U.PDF)

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A 4K video of the flight is viewable through this QR code or by searching AATI DLA flight on Youtube: (Destination is Youtube.com)

