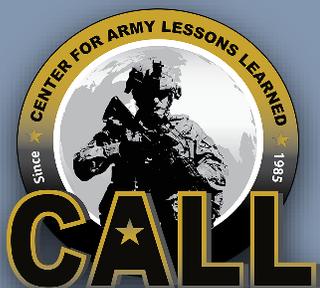


NEWS FROM THE FRONT

5 January 2018

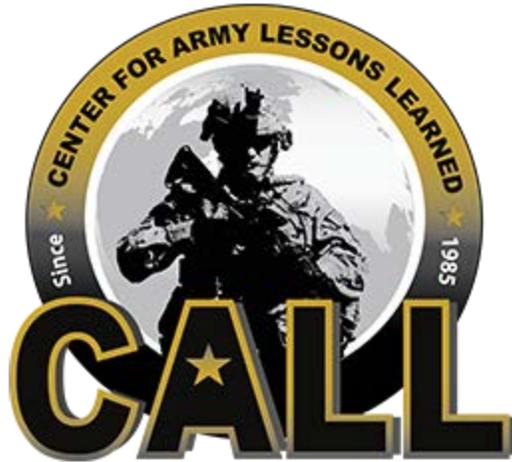


Hurricane Maria Relief Operations

Lessons and Best Practices

**LTC George Chigi, Center for Army Lessons Learned, Division Chief
Mr. Donald Haus, Strategic Analyst, Center for Army Lessons Learned**

Approved for Public Release
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News from the Front: Hurricane Maria Relief Operations

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The contents of this document were acquired during a collection in Puerto Rico during the Hurricane Maria emergency relief efforts from 7-19 October 2017.

Unless otherwise attributed, photographs provided by LTC George Chigi, Center for Army Lessons Learned.

Disaster Support of Civil Authorities (DSCA) Lessons

"We're working in direct support of FEMA. The military is not in charge here. The governor is in charge. They're supporting the governor, and we're supporting FEMA."

LTG Jeffery Buchanan
Joint Force Land Component Commander (JFLCC)

Source MSN News: <https://www.msn.com/en-us/news/other/lt-gen-jeffrey-buchanan-pushes-back-on-criticism-of-trump-e2-80-99s-puerto-rico-response/ar-AAAsCH4T>

The purpose of this article is to share initial lessons and best practices observed by the units supporting the relief efforts in Puerto Rico following the landfall of Hurricane Maria. The intended audiences for the Center for Army Lessons Learned (CALL) outputs are Major Commands (MACOMs), interagency partners, and Commanders and staffs executing Disaster Support of Civil Authorities (DSCA) missions.

On 20 September 2018, a category 5 hurricane made landfall on the U.S. island territory of Puerto Rico and the Virgin Islands. Hurricane Maria's 155 mile per hour winds and rain overwhelmed Puerto Rico's emergency response capabilities. The Puerto Rico Emergency Management Agency (PREMA) headquarters building was destroyed further complicating the territory's response. Twenty-four hours after Maria's landfall United States Army North (ARNORTH) assets were in Puerto Rico to help coordinate and provide military assets for the recovery. This initial force would eventually grow to over 15,000 Soldiers and Department of Defense (DOD) personnel. Within hours of Hurricane Maria's winds dropping to acceptable limits, Air Force aircraft landed under night vision conditions, set up infra-red beacons, and established minimal power requirements to begin landing follow on aircraft. In the initial three weeks, the Joint Force Land Component Command (JFLCC) was responsible for flying more than 1,400 sorties in support of relief efforts. Naval and Marine assets supported off shore with the U.S.S. Comfort hospital ship and support to the Virgin Islands. One of the primary goals for the DSCA operations is to get the state or territory into a position where it can get back to daily life sustaining operations.

Two CALL analysts deployed to Puerto Rico to collect direct observations, lessons, and best practices. ARNORTH's mission was to serve in the role of a JFLCC conducting Hurricane Maria DSCA. At the request of the Army North (ARNORTH) commander CALL was integrated into the JFLCC staff to collect insights across the entire island of Puerto Rico. Hurricane Maria disabled nearly all communications, making coordination with any entity impossible. This had a great impact on how the territory of Puerto Rico and its municipalities were able to direct Federal Emergency Management Agency (FEMA) and DOD assets.

By October 8, 2017 the number of DOD generators installed in Puerto Rico had exceeded what was installed from the combined Florida and Texas hurricane relief, and had brought Puerto Rico's power generation to pre-hurricane levels (albeit in limited areas).

Before Hurricane Maria: Visible lights of Puerto Rico and the Virgin Islands

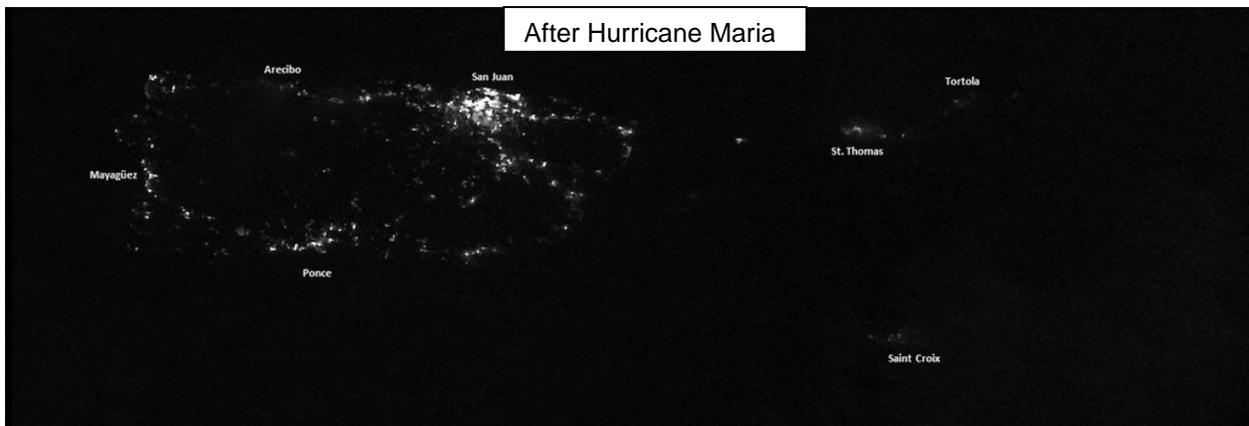


Figure 1-1 Satellite photos from National Oceanic and Atmospheric Administration (NOAA) show Puerto Rico and the Virgin Islands visible lights before Hurricane Maria (24 July 2017) and after (25 September 2017). Source: NOAA Twitter site.

JFLCC Assessment. The overall assessment from the JFLCC leaders and staff is that there must be a strong situational understanding of the environment to affect change. As the local capabilities were crippled, FEMA and the JFLCC's bottom-up refinement on situational understanding had to be heavily augmented by military units and often word of mouth. Additionally, the JFLCC needed a clear idea of what transitions must take place to quickly return control to the local government. This provided the chain of command with a guide to measure progress in the relief efforts and the local authorities' ability to manage the operation. The slow build of capability from the scattered Puerto Rican National Guard and Reserve forces caused active duty military forces to regularly

re-evaluate how they employed Title 10 and 32 forces with the authorities they were granted.

The 2017 hurricane season (1 June – 30 November) had not been the most active ever recorded, it comes at the end of a fairly long quiet period of Atlantic (North Atlantic Ocean, Gulf of Mexico, Caribbean Sea) hurricane activity. It had produced not only two back to back major hurricane landfalls (Harvey and Irma) along the U.S. coast with devastating results, it also produced the third strongest hurricane ever to hit the U.S., Hurricane Maria, which is regarded as the worst natural disaster on record in Puerto Rico.

The National Weather Service defines a hurricane as "an intense tropical weather system with well-defined circulation and sustained winds of 74 miles per hour (mph) (64 knots) or higher."



Figure 1-2 Soldiers prepare to distribute food and water (courtesy FEMA/Hurricane Maria DVIDS site)

Hurricanes are rated according to intensity on the Saffir-Simpson Hurricane Wind Scale:

Category 1 74-95 mph **Very dangerous winds will produce some damage:** Well-constructed frame homes could have damage to roof, shingles, vinyl siding and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days.

Category 2 96-110 mph **Extremely dangerous winds will cause extensive damage:** Well-constructed frame homes could sustain major roof and siding damage. Near-total power loss is expected with outages that could last from several days to weeks.

Category 3 (major) 111-129 mph **Devastating damage will occur:** Well-built framed homes may incur major damage or removal of roof decking and gable ends. Electricity and water will be unavailable for several days to weeks after the storm passes.

Category 4 (major) 130-156 mph **Catastrophic damage will occur:** Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months.

Category 5 (major) 157 mph or higher **Catastrophic damage will occur:** A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months.

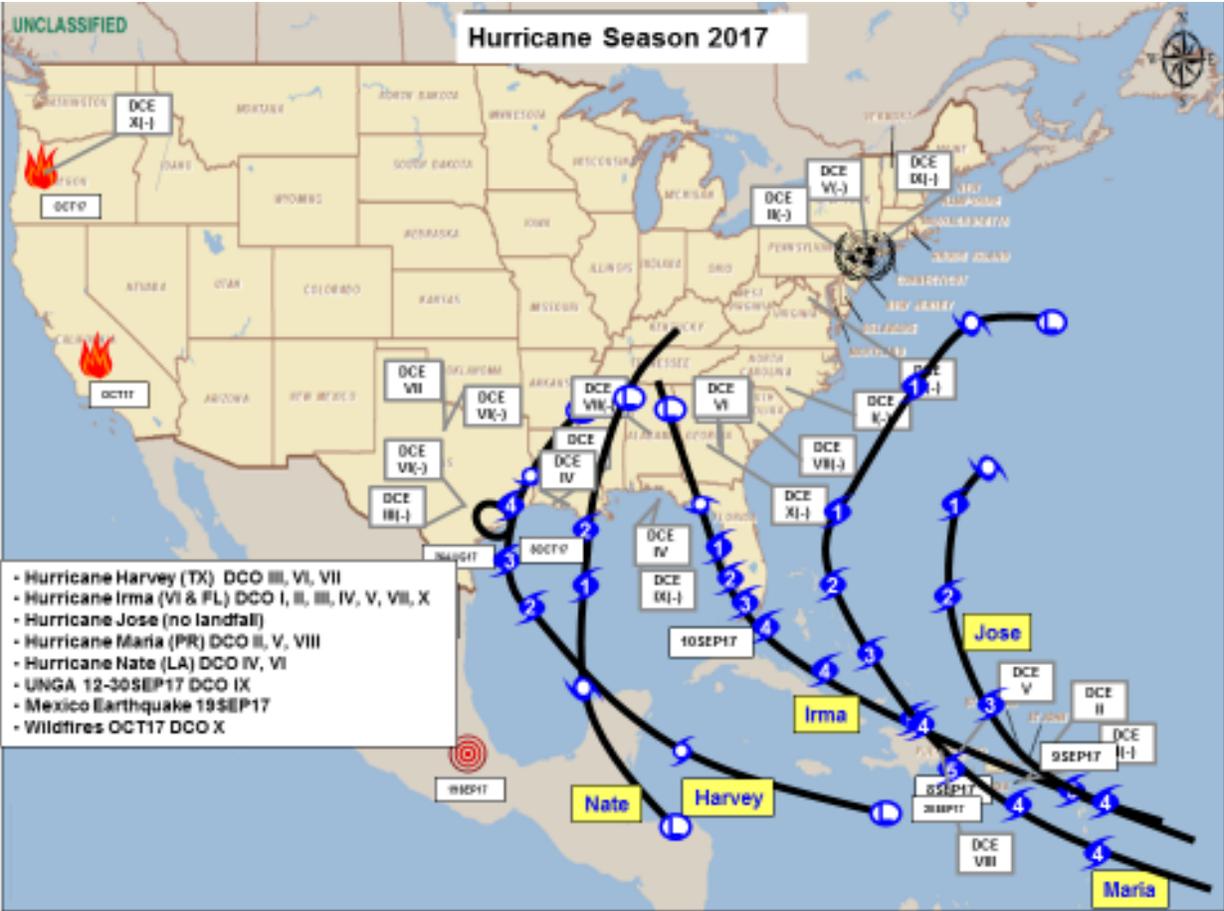


Figure 1-3 Representation of the 2017 hurricane season depicting the five named storms, their path, their strength, along with which Defense Coordinating Officer (DCO) and Element (DCO/E) were activated. Along with the hurricanes, this figure also depicts the western states wildfires and the United Nations support in New York.

Hurricane Maria Timeline

- September 16, 2017 - Tropical Storm Maria forms about 620 miles east-southeast of Lesser Antilles.
- September 17-18, 2017 - Maria rapidly intensifies from a tropical storm into a Category 5 hurricane.
- September 18, 2017 - The storm hits the Caribbean island of Dominica as a Category 5 hurricane and devastates the area.
- **September 20, 2017 - Makes landfall near Yabucoa in Puerto Rico as a Category 4 hurricane. It is the strongest storm to hit Puerto Rico in 85 years. The energy grid was heavily damaged, with an island-wide power outage.**

- September 22, 2017 - The National Weather Service orders the evacuation of about 70,000 people living near the Guajataca River in northwest Puerto Rico because a dam is in danger of failing. The storm continues to churn northward, making landfall in the Caribbean islands of Turks and Caicos as a Category 3.
- September 26, 2017 - Maria weakens to a tropical storm as it heads northeast out to sea.

Trends Common to all Units in support of Puerto Rico's DSCA operations

Common Operational Picture varied by unit (COP). For enduring or static missions the Google - Situation Awareness Geospatial Enterprise (SAGE) software COP that the JFLCC employed was functional and provided FEMA the situational awareness (SA) it required. The COP required a constant network connection, and at times was challenged in those missions that were quick response, required movement, or constant updates. FEMA's disparate COP existed in various, unsynchronized pieces throughout the Joint Field Office (JFO) floor, and conversations with key staff members in FEMA suggested that they did not have a strong understanding of what JFLCC missions were ongoing. Units subordinate to the JFLCC used various COP formats such as an analog map, a PowerPoint concept sketch, Blue Force Tracking (BFT) / Joint Capability Release (JCR), or Google-SAGE (as network strength improved). These individual COPs functioned as desired for the units, but the less capable COPs did have the risk of becoming overwhelmed if information flow improved.

Situational Understanding: Analysis of the Joint Operating Area (JOA). Units operating in support of this mission all agreed that an in-depth analysis of the JOA is necessary to identify the right kind of unit to employ, and to ensure their roles are defined and understood. The units that were most noticeably effected by this trend were aviation, logistic, and medical. Numerous units commented that they felt unprepared, or that they did not bring the right resources for the mission. In some cases, this was connected to not understanding the scope of the disaster. In other cases, this ambiguity was connected to receiving guidance that detailed "who" and "what" kind of capability was needed as opposed to what results were desired.



Figure 1- 4 Soldiers and the U.S. Army Corps of Engineers repair damage to the Guajataca Dam.

Liaison Officer (LNO) use in the FEMA Joint Field Office. LNOs proved a success in this environment. They provided subject matter expertise level understanding to FEMA. Nearly every subordinate JFLCC organization had LNOs with FEMA. It is unclear if the JFLCC will need as many LNOs in a different DSCA mission where the State is more prepared. In the case of Hurricane Maria's DSCA response, the LNOs were a necessity as the State was not yet capable, and FEMA needed more expertise to help coordinate and plan down to the tactical level.

Mission Command. All units quickly realized that they would have to rely on Mission Command over mission command systems. Over-the-horizon communications were in short supply, units were separated by as much as 60 miles, and individual missions could be lengthy. Commanders began with detailed planning and intelligence preparation of the battlefield IPB to prepare the team. This was followed with clear task, purpose, and intent. These steps clearly gave leaders the understanding they needed to execute with disciplined initiative. Several commanders commented to CALL that they appreciated the level of trust they were given by the JFLCC chain of command.



Figure 1-5 Soldiers from the 2-501st General Aviation Battalion, 1st Combat Aviation Brigade, 1st Armored Division, prepare a CH-47 for relief operations at the Roosevelt Roads Naval Air Station

FEMA Mission Assignment tasks to DOD. FEMA uses a Mission Assignment Tasking Order (MATO) to describe task and purpose for a mission concept or a specific mission. The MATO is similar to a task to subordinate units within an operations order. After the overarching MATO is approved, FEMA Emergency Support Functions (ESF) are comfortable with non-standard forms of directly communicating task and purpose (phone call, e-mail, post-it notes) to the military units. This created a potential for unnecessary staff work. From the FEMA and DCE point of view, this method worked, but to the executing units, it was received as last minute planning that never got beyond a 24-hour planning horizon. ***Units newly assigned to DSCA will have to be prepared for this different method of planning and execution when working with FEMA and local authorities.***

“Don’t let the process frustrate you. Continue to work the mission towards success as opposed to becoming discouraged by details and roadblocks in the planning process.” --- Colonel Sharon Miller, Defense Coordinating Officer (Region 5)



Figure 1-6 Portable mobile phone repeater van in Costa Azul, Puerto Rico

Communication Equipment. DSCA units are expected to operate in an austere environment, often-needing over-the-horizon capability and compatibility with civilian systems; Army Modified Table of Organization & Equipment (MTOE) does not account for a DSCA communication system(s). Several units expressed a need for an update to their MTOE that would allow for this added capability, or a communication suite package that is available for units on DSCA missions to draw. The equipment would require periodic re-evaluation as technology improves or older equipment fails to work well.

“When deployed, the satellite band-width is very high, in Continental United States (CONUS) and Puerto Rico the satellite availability is much lower, creating gaps in capability.” --- Colonel Jay Hopkins, Commander 1st Combat Aviation Brigade, 1st Armored Division.

Current Conditions in Puerto Rico as of 02 Jan 2018

Water Production	86.36%	AAA
Power Generation	65.40%	AEE Generation
Tele Com	95%	JRTC
Cell Sites	89.55%	JRTC
Gas Stations	88%	DACO
Supermarkets	92%	MIDA
Business Processing PAN	76%	Departamento de la Familia
Shelters (Open)	18	Vivienda
Sheltered Individuals	298	Vivienda
Assisted Hospitals	68 100%	Departamento de Salud Federal y Local
Assisted Dialysis Centers	96%	Departamento de Salud Federal y Local
Processing Pharmacies	95%	ASES
Open Ports	100%	Puertos
Diesel Supplied	1,163,245 Barrels	DACO
Gasoline Supplied	1,455,531 Barrels	DACO
AMA Routes (Public Transportation)	100%	DTOP
Post Offices	100%	USPS
Milk Industry	97.24%	Departamento de Agricultura de PR
Air Traffic Commercial/Domestic/International	Normal	AeroStar
Tourism	Hotels – 76% Casinos – 83%	Compañía de Turismo

Source: <http://status.pr/>

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In the days leading up to Hurricanes Harvey, Irma, and Maria (Texas, Florida, Puerto Rico/Virgin Islands) CALL sent push packages of lessons, best practices, and handbooks to units that would be conducting hurricane DSCA. Over the next year, the Army Lessons Learned Forum General Officer Steering Committee will be addressing emerging problems and assigning the appropriate authority to produce solutions from a Doctrine, Organization, Training, Materiel, Leadership, Personnel, Facilities, and Policy (DOTMLPF-P) perspective.

Before the June 2018 hurricane season begins, CALL will produce and update a number of written products to help the Army improve and prepare for disaster operations:

- Combined hurricane report for Hurricanes Harvey, Irma, and Maria.
- Hurricane Maria collection report.
- Update of DSCA CALL publications.
- A number of *News from the Front* articles and bulletins from the senior- leader level interviews and data gathered.

Tactical Lessons, Best Practices, and Recommendations

Recommendation. Before executing the DSCA operation the joint command element would benefit from a deliberate and collaborative planning process with all of the major commands within the JFLCC. This would allow all elements to identify what equipment and supplies were needed for initial entry into the DSCA JOA, and what resources could wait for follow-on echelons.

Best Practice. Consider those forces already on the ground. Rather than ask for additional assets and units to be deployed, identify what local units (National Guard, Reserve) are already in place that can be officially ordered to support the mission. A deliberate Emergency Management Agreement Compact between states can also be used to posture nearby units to support.

Best Practice. Maximize life-sustaining supplies on every helicopter. 1st Armored Division (AD) combat aviation brigade (CAB) personnel prepared food, water, and baby formula to be distributed. Soldiers provided every rotary wing asset (military, DOD, local law enforcement) with basic necessities to distribute. This specific effort was the direct guidance of the CAB commander to utilize every air mission, no matter the destination or purpose, to take food and water to those in need. Before departing the airfield nearly every helicopter does a quick landing at the supply point and loads up.



Figure 1-7 1st CAB, 1st AD Soldiers prepare food and water for every helicopter that departed the airfield.

Best Practice: Key medical capabilities are needed in DSCA. (1) A Preventive Medicine Detachment is crucial as many of the medical conditions in a DSCA environment are the result of hygiene, poor living conditions, and follow-on injury recovery. (2) A Veterinary Detachment is helpful for providing guidance on food preparation and inspecting local contracts for food distribution. (3) Situational awareness of unit organic medical capabilities that come with subordinate level units (medical platoons, physician's assistants, surgeons, ROLE 1 capabilities, etc.).

Lesson: Class 8 into theater. The combat support hospital (CSH) deploys into a DSCA theater of operation with personnel, equipment, and very little Class 8 medical supplies. Bulk Class 8 meets the CSH in theater (approximately 24 hours after CSH personnel arrive) with following echelons to maximize haul capability as the theater builds capability. Planners should be aware that initial medical capability is minimal until combat power builds.

Best Practice: Daily Airfield/Point of Distribution Synchronization meeting. Both aviation and logistics units were in locations where they shared real estate with joint forces, DOD, and numerous government agencies. A daily meeting to coordinate assets and efforts was necessary to avoid friction and redundancy.



Figure 1-8 68th CSSB (4 ID) Tactical operations center (TOC) expando-vans and equipment on the Auguadilla airfield

Airlift Lesson. DOD and FEMA were competing for the same haul capabilities. The military and FEMA each knew what they needed to get onto the island for their specific mission sets. These priorities were not aligned and synchronized across the greater fight, resulting in capabilities that the military wanted, but FEMA may not have necessarily seen as crucial at that point in time.

Lesson: Aviation Tactical Cross-load. The 2-501st General Aviation Battalion leadership recommended that the airlift of rotary wing assets should send packages that allow the lift of assets to become mission capable upon arrival. Initial plans for deploying the general support aviation battalion (GSAB) were based on getting all “like” equipment and units into Puerto Rico. This created C5 lifts that had groups of resources. After the first two lifts were cancelled due to maintenance issues, 2-501st quickly realized that the third C5 lift (that became the first) would land on the island and not be mission capable without follow on lifts.

Lesson: Torch Party. Soldiers of the 2-501st Arrived at the Roosevelt Roads Naval Air Base where there was virtually no infrastructure to support a military unit. The 2-501st recommended that the first echelon of personnel include a pay agent, a contracting officer’s representative, and a legal capability to work through establishing minimum life support to begin receiving the organization.

Best Practice: Air Space Coordination System. Puerto Rico had air space management through the Federal Aviation Administration (FAA), but only in and around managed airports. The 1st AD CAB commander and staff quickly realized this, and built corridors and promulgated their plan with the JFLCC and FEMA to synchronize rotary wing missions throughout the island. A CAB commander and staff provided a necessary level of experience and authority to represent aviation requirements.



Figure 1-9 The Roosevelt Roads Naval Airfield had to accommodate and synchronize both military and civilian aircraft.

Best Practice. The CH-47 helicopter has rollers on the floor of the cargo area to move supplies. The rollers are not compatible with the civilian wooden pallets. Units deploying to a DSCA environment would benefit by arriving with pre-cut plywood sections (48" x 40") to place under civilian pallets for quick on and off loading.

Best Practice. The 2-501st placed additional personnel on their aircraft to rapidly load and unload supplies. While there was slightly less cargo that could be transported with the extra off load team, the gain in efficiency and time made a huge impact.

Military Equipment for Civilian Applications. The 2-501st recommended that aviation units purchase a disposable sling load capability. Military slings, nets, and hooks are expensive and require recovery. This may not be an option in the event that supplies for relief are being dropped into remote locations (mountain passes, small villages without LZs, blocked roads). The 2-501st is in the process of purchasing 100-foot sling cables (from the "Helihook" company) that allow rotary wing to hover at a distance and detach loads of commodities into remote areas where landing or low hover is not an option.



Figure 1-10 Major Ben Jackson shows CALL Analyst Mike Robinson a disposable cargo bag used for dropping supplies into remote areas, and delivering dirt to repair the Guajataca Dam.

Best Practice: Sustained Maintenance. Most of the recent hurricane DSCA operations did not extend beyond 2 weeks. It is recommended that units plan for phased maintenance of equipment if the mission lasts more than a month. A maintenance plan where equipment can be echeloned on and off mission, while still having a capability available for relief efforts, will be necessary in lengthy DSCA operations.

Best Practice. 4th Sustainment Brigade (4 ID) sent teams of logisticians into the community to understand the demand signal for life sustaining commodities. Additionally, they identified how long each supply run would sustain that community and built a recurring package to be delivered every 24-72 hours.



Figure 1 - 11 Soldiers provided 15,000 gallons clean drinking water, daily, to the people of Guajataca using a Reverse Osmosis Water Purification Unit.

FEMA

2017 HURRICANE SEASON

Unprecedented

25.8 Million
people were affected by hurricanes
Harvey, Irma and Maria.

FOR THE RECORD

- 2** First time 2 Atlantic Category 4 Hurricanes (Harvey and Irma) made landfall in the continental U.S. in the same year.
- Hurricane Harvey grew from a regenerated tropical depression to a Category 4 hurricane in **56 hours**.
- Harvey set a new record for the most rainfall from a U.S. tropical cyclone, with more than **50" of rain** and remained a cyclone for nearly 5 days after landfall.
- Hurricane Irma became the strongest Atlantic Ocean hurricane on record with winds peaking **over 185mph** and remained a hurricane for **11 days**.
- Hurricane Irma was **500 miles wide**, more than **130 miles wider** than the entire state of Florida.
- Hurricane Maria was the **First Category 4 hurricane in 85 years** to make landfall on the main island of Puerto Rico.
- Over 700 generators** installed in Puerto Rico by the USACE.

48 states and the District of Columbia assisted with operations from Texas to U.S. Territories in the Caribbean, through Emergency Management Assistance Compacts.

as of November 30, 2017

FEMA

2017 Hurricane Season

by the Numbers

4.7+ Million >
Survivors Registered for Individual Assistance
In the continental U.S., USVI, PR

TOTAL: 30 PRESIDENTIAL DECLARATIONS
SINCE HURRICANE HARVEY MADE LANDFALL

- 14 Emergency Declarations
- 16 Major Disaster Declarations
- 25 Fire Management Assistance Grants

More Registrations than RITA WILMA + KATRINA + SANDY COMBINED

Post Irma & Maria Puerto Rico
Largest sustained air mission Food & Water

+10x call center staff increased from steady state

more than **4x** # OF HOUSING INSPECTORS TO VALIDATE DAMAGES

NEARLY **8%** OF THE U.S. POPULATION AFFECTED THIS SEASON

\$2+ Billion In disaster assistance Paid to Survivors

133,000 FLOOD INSURANCE CLAIMS

\$6.3+ Billion Paid out to date

as of November 30, 2017