



Hormigueros Landfill
January 27, 2017

Puerto Rico's Waste Management Infrastructure

...an educated third-party perspective on 2017 Hurricane Season's impact

Hanna K. Rodriguez-Morales, PE, SC



Our 100x35 Reality



Google

Imagery ©2018 Data SIQ, NOAA, U.S. Navy, NGA, GEBCO, Landsat / Copernicus, Map data ©2018 Google Puerto Rico Terms Send feedback 10 km

Legal Framework

- 1978 - Creation of PRSWA
- 1992 - Recycling Act
- 2003 - Waste Characterization Study
- 2003 - Landfill Lifespan Study
- 2004 - Strategic Plan for Solid Waste Management (PERMS) & PREQB – Permitting
- 2008 - Infrastructure Dynamic Itinerary

Baseline Waste Management Issues

- Compliance
- Landfills are PR's only means of disposal
- Tipping fees are low!
- Lack of funding streams for infrastructure improvements, closure, and post-closure costs
- Low diversion and recycling rates

PR Waste Management News

Limited landfill space



Print Close

Overflowing landfills choke Puerto Rico amid economic crisis

Published April 21, 2017

Associated Press

TOA BAJA, Puerto Rico – At first glance, it looks like people have abandoned this rural community tucked into Puerto Rico's soft rolling hills: the windows are shut, the doors closed and the gates locked.

But everyone is still here, just sealed inside their homes to shield themselves from the stench, flies and feral dogs of the nearby landfill that has expanded so much it is now just steps away from their front doors in Villa Albizu near Puerto Rico's north coast.

"You have no idea what it's like to gulp in that smell 24 hours a day, 365 days a year," said Yahaida Porrata, whose house is roughly 10 steps from the landfill. "You have to shutter the house completely because you can't breathe ... If I had the money, I would have moved a long time ago."

The majority of landfills across Puerto Rico are over capacity and groaning under tons of liquefied garbage seeping into the tropical soil and posing threats to people and the environment, according to the U.S. Environmental Protection Agency. Nineteen of the island's 29 landfills are violating federal laws, yet they still accept a large portion of the 8,500 tons of garbage that Puerto Ricans generate daily. The EPA has ordered local officials to close 13 of those landfills including the one in front of Porrata's home because of the health risks they pose, but a decade-long economic crisis has prevented that from happening.



La EPA advierte el inminente cierre de más vertederos en Puerto Rico

Los municipios anticipan impactos negativos si los sistemas dejan de recibir desperdicios

Por: La Esfera de 04/21/17 - 10:48 AM
Por: Vanessa K. Alvarado Lora



La EPA analiza alternativas para que los vertederos existentes no operen al límite y para que, en consecuencia, se evite cualquier riesgo de contaminación. (EPA Media)

Los vertederos de Adams, Barranquitas, Guayama, Horripicuros, Jayuya, Juana Díaz, Mayagüez y Vieques operan en incumplimiento con las normas aplicables y están en riesgo de recibir una orden de cierre de la Agencia Federal de Protección Ambiental (EPA, en inglés).

EPA: Puerto Rico Landfill Must Close by July 2019

SAN JUAN – The U.S. Environmental Protection Agency has reached an agreement with the Municipality of Santa Isabel to complete final closure of its municipal solid-waste landfill by July 2019, implement environmental protection controls following closure, implement a recycling program, and pilot a composting program. The municipality is no longer receiving waste at the Santa Isabel landfill.

"The EPA is continuing to assess landfills throughout Puerto Rico that have reached or exceeded capacity and created conditions that threaten public health and the environment," said EPA Acting Regional Administrator Catherine McCabe in the EPA's release. "It is imperative that owners and operators of landfills in Puerto Rico live up to their responsibilities to operate and close these landfills properly in order to protect the health of nearby communities."

Under the proposed settlement, Santa Isabel agrees to pay a civil penalty of \$20,000, with interest, and to comply with terms of the consent decree. In addition to completing final closure of the landfill, the municipality must also:

- maintain an interim cover over the landfill to help control odors and blowing debris
- ensure adequate fencing and security at the landfill
- install and operate a groundwater monitoring system to be approved by the EPA
- implement a recycling program to help minimize the volume of waste materials in Puerto Rico landfills
- implement a pilot composting plan to minimize disposal of food waste in Puerto Rico landfills
- perform community outreach to inform the public about recycling; and
- implement a mosquito control plan at the landfill to help fight the Zika virus.

Failure to comply with the terms of the proposed consent decree subjects the municipality to penalties.

Pre-2017 Hurricane Season

Hanna K. Rodríguez Morales, PE, SC | 2018 | AICHe Hurricane Disaster Infrastructure Resilience and Planning Workshop II



Ref.: ENDI, Fox News, Caribbean Business

PR Waste Management News

Pay As You Throw (PAYT)



SWANACARIBBEAN @swanacaribbean · 28 Jun 2017

Amazing event on #PAYT in PR. Thanks to all the speakers & attendees for cordial discussion on the matter waste management financing!



1 5

El periódico #1 en circulación impresa promedio de lunes a viernes

el Vocero

de Puerto Rico

Estudio revela que los municipios tienen otras alternativas antes de meter la mano en el bolsillo del consumidor.

Los CPA dicen: NO AL COBRO POR LA BASURA

En la recta final luchamos por el derecho de los puertorriqueños a un medio ambiente limpio y saludable.

lunes, 30 de enero de 2017

Atender la disposición de basura es asunto de País

La intención de municipios de cobrar a los ciudadanos por el recogido de los desperdicios sólidos confronta otra vez al País con su pobreza de disposición de residuos, un problema que hay que atender mediante programas de reciclaje eficientes y la consolidación de recursos de las regiones municipales.

Municipios quieren cobrar por recoger la basura

Ante la inminente eliminación de subsidios y el alto costo por la disposición de los desperdicios sólidos

lunes, 30 de enero de 2017 - 3:34 PM

El País quiere a destiempo implementar reformas estructurales para implementar el cobro por recogida de basura. (ENI)

Pre-2017 Hurricane Season

Hanna K. Rodríguez Morales, PE, SC | 2018 | AIChe Hurricane Disaster Infrastructure Resilience and Planning Workshop II

Ref.: ENDI, El Vocero, SWANA Caribbean on Twitter



PR Waste Management News

Coal Combustion Residuals (CCRs)



EPA insists that ash is not dangerous

Carmen Guerrero validates claims of the neighbors of Peñuelas and calls for dialogue with the government

Thursday, July 27, 2017 - 9:25 AM
By Gerardo E. Alvarado León



Carmen Guerrero explained that, since October 2015, EPA identifies coal ash and its derivatives as nonhazardous solid waste, in accordance with the Coal Combustion Residuals Rule or CCR Rule. (Teresa Canino)

INSULT TO INJURY

Puerto Rico had towering landfills and coal ash pollution. Then, Maria hit.

By Yessenia Funes on Sep 29, 2017

Tweet

Share

More than a week has passed since Hurricane Maria made landfall on Puerto Rico, and still little word has come from remote parts of the island — like the southeast, for example, where many residents of African descent, as well as industrial sites, are concentrated.

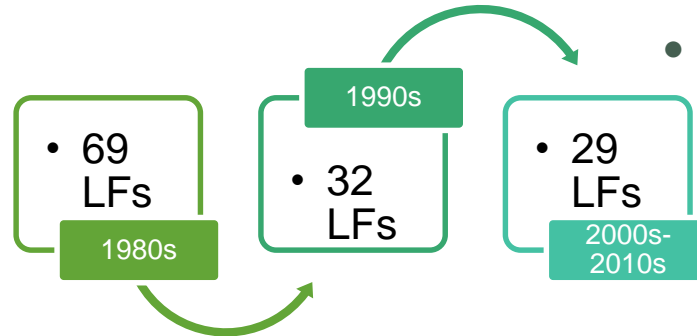
Puerto Ricans living outside the island are struggling to reach friends and family members. And from Grist and others' reporting, [the situation on the ground](#) is looking grim. [Conservative estimates by NASA](#) show that Maria, which hit the U.S. territory as a Category 4 storm, dropped nearly two feet of water on Puerto Rico in a single day. That's the amount of rainfall so-called dreary London gets [in a year](#).



Pre-2017 Hurricane Maria Status

Landfills Situation – Environmental Crisis

- Operation
 - Expansions
 - Closure Orders
 - AOC with EPA (expansion)
 - New facilities, PPP
- 29 landfills (USEPA, Nov. 2016)
 - 19 continue using unlined cells
 - 12 under legal agreement with EPA
 - PRSWA & PREQB, April 2014
 - 3 Compost Facilities
 - 115 Recyclable Materials Collection Facilities
 - 4 Recyclable Materials Facilities (MRFs)

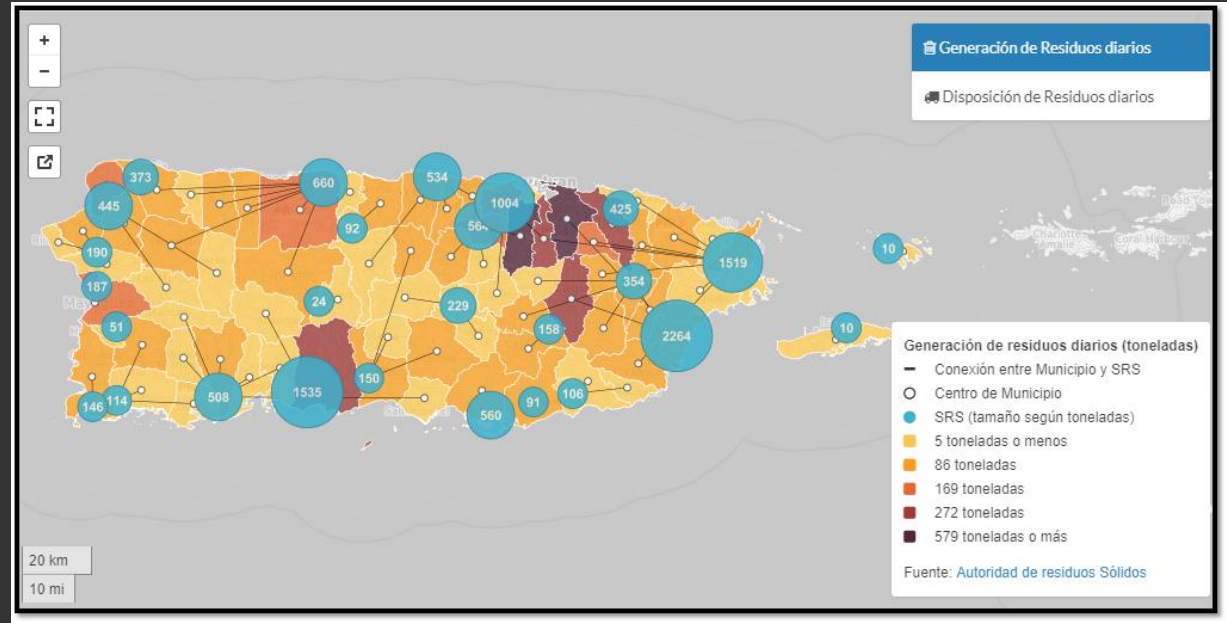


PR Waste Generation

Waste

Generation Rate:

- 5.56 pounds per person per day
- 70% disposed of in landfills

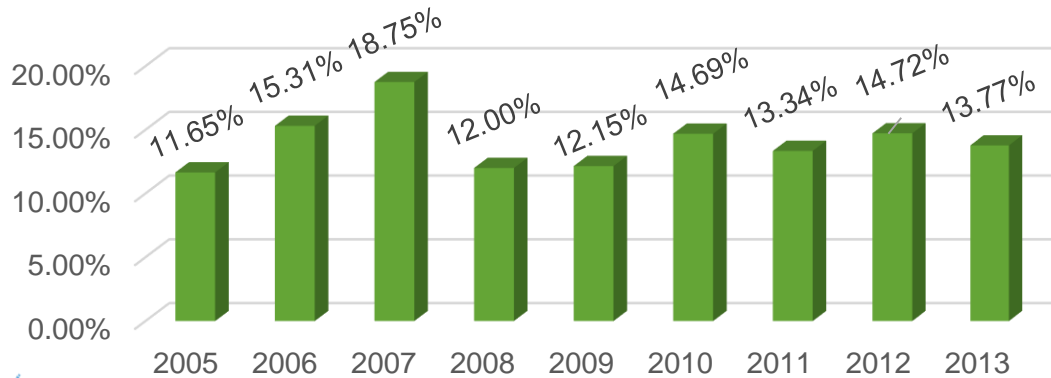


Ref.: PRSWA Interactive Map <http://www.ads.pr.gov/mapas/mapa-srs.html>

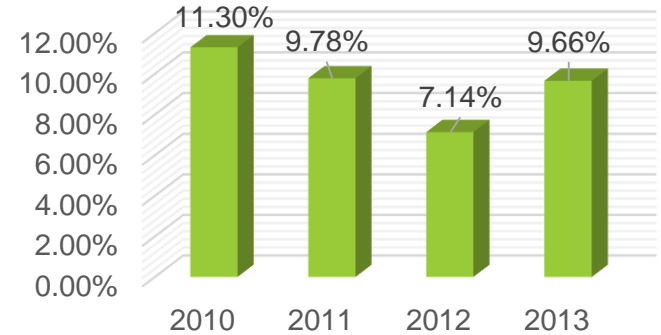
Pre-2017 Hurricane Maria Status

As per the Puerto Rico Solid Waste Management Authority (PRSWA)

Diversion Rates



Recycling Rates





PR Climate Change Council (PRCCC)

- Ensure a coordinated effort in assessing risks and impacts from coastal hazards and climate changes and in recommending adaptation strategies.
- Works towards the following objectives:
 - Use the best available scientific knowledge;
 - Identify, assess, prioritize, and develop effective adaptation strategies and policies;
 - Communicate findings, consensus, and recommendations to government, civil society;
 - Cultivate a well-informed Puerto Rican society.





- **Working Group 3:** Society and Economy
- **Focus:** Critical Infrastructure
- **Collaborating Organization:** Natural Disaster Management Commission of PR's Professional College of Engineers and Land Surveyors



Assessment Methodology – ISO 31000

Waste Management
Industry infrastructure
components, or service
chain elements evaluated

- Collection, Transfer and Transport Systems,
- Segregation and Materials Recovery
- Treatment and Energy Recovery
- Disposal

Significant Single Events

- 0.5 meter sea level rise
- 1 meter sea level rise
- Storm surge scenario based on Category 1 through 5 hurricane flood

Ongoing/Cummulative Events

- Greenhouse Gas (GHG) emissions increase
- Temperature variability
- Precipitation Patterns

WM Infrastructure Risk Register Results

Risk Treatment or Adaptation Measures (existing or potential)

1. **Train emergency response personnel in site-specific risks or vulnerabilities**; improve operator-response agency communication.
2. **Improve weather prediction technology and communications.**
3. Promote Best Available Control Technology (BACT) and Best Management Practices (BMPs) when designing, constructing, and operating Landfill Gas (LFG) systems.

WM Infrastructure Risk Register Results

Risk Treatment or Adaptation Measures (existing or potential)

4. Improve **monitoring** technology to improve statistics and projections.
5. **Research and development opportunities** in the island's solid waste industry.
6. Promote waste diversion by implementing **Integrated Solid Waste Management (ISWM)** alternatives.
7. Ensure no landfill **expansions** towards potentially affected (or vulnerable) areas are approved or built.



Ref.: NASA/NOAA GOES Project

2017 Hurricane Season

Several storms that developed “on each other's heels” from Aug. 17 to Sept. 16:
Harvey, Irma, Jose, Katia, Lee and Maria

Waste Management News shifted

After Maria, Puerto Rico Struggles Under The Weight Of Its Own Garbage

December 14, 2017 - 6:29 PM ET
 Heard on All Things Considered

MERRIT KENNEDY LAUREN MIGAKI

Listen - 3:39 Queue Download Transcript



The active part of the landfill in Toa Baja is currently a hot, rancid, open dump. Federal regulations require trash piles to be covered daily with earth. But the site's supervisor says that's currently impossible.

Jose Jiménez-Trinco for NPR

Ref.: ENDI, Fox News, Caribbean Business

US Army Corps of Engineers
 BUILDING STRONG

USACE expands debris removal operation in Puerto Rico

Posted 10/26/2017
 Release no. 17-113

Contact:
 Ed Rivera
 edward.rivera@usace.army.mil
 317.694.9679 (cell)

In order to expedite the debris removal process, debris should be placed curbside, but ensure that the debris is not blocking the roadway. Placing debris near trees, poles, fire hydrants, meters or other structures makes removal difficult.

Debris should be separated into six categories:
Electronics: Television, computer, stereo, phone, DVD player
Large Appliances: Refrigerator, washer/dryer, air conditioner, stove, water heater, dishwasher (ensure doors are sealed and secured)
Hazardous Waste: Oil, battery, pesticide, paint, cleaning supplies, compressed gas
Vegetative debris: Tree branches, leaves, logs, plants
Construction Debris: Building materials, drywall, lumber, carpet, furniture, plumbing
Household Garbage: Bagged garbage, discarded food, paper, packaging

For more information on debris removal contact your local municipality.

Photos

U.S. Army Corps of Engineers debris removal teams, in coordination with FEMA, are actively conducting debris removal operations in Toa Baja, San Juan, Puerto Rico, on

US Army Corps of Engineers Chose Only One Company to Collect Majority of Puerto Rico's Hurricane Debris

By CENTER FOR INVESTIGATIVE JOURNALISM (CPI) DEC 21, 2017 CLIMATE NEWS

Share

Street of Villa Cañona in Loíza, Puerto Rico, three months after Hurricane Maria. (Eduardo Meléndez | Center for Investigative Journalism)

Debris removal becomes a lucrative business

Municipalities grant millions in contracts to clean up their communities

Florida, November 13, 2017 - 8:00 AM
 By Wilma Maldonado Argente | Gabriela Nolasco Amador



(Karter J. Andujar Berrios)

The accumulation of contracts, companies, referrals and bureaucratic procedures for debris removal and vegetative material after the passage of Hurricane Maria seems as monumental as the mountains of waste still in front of residences, arenas and roads throughout Puerto Rico.

However, the multimillion amount in contracts for the collection of debris and vegetative material is still unknown exactly.

Post-2017 Hurricane Season

Hanna K. Rodríguez Morales, PE, SC | 2018 | AIChE Hurricane Disaster Infrastructure Resilience and Planning Workshop II



Legislative Updates

Proposals and New Legislation

- Task force created by PREQB for Emergency Solid Waste Management
- Public policy to fight climate change in Puerto Rico proposed
- Municipalities are allowed to create and manage temporary vegetative and construction debris collection centers, following certain guidelines
- PREQB approves thermal treatment of debris via waiver
- Microgrid development regulation

Post-Hurricane Maria Timeline

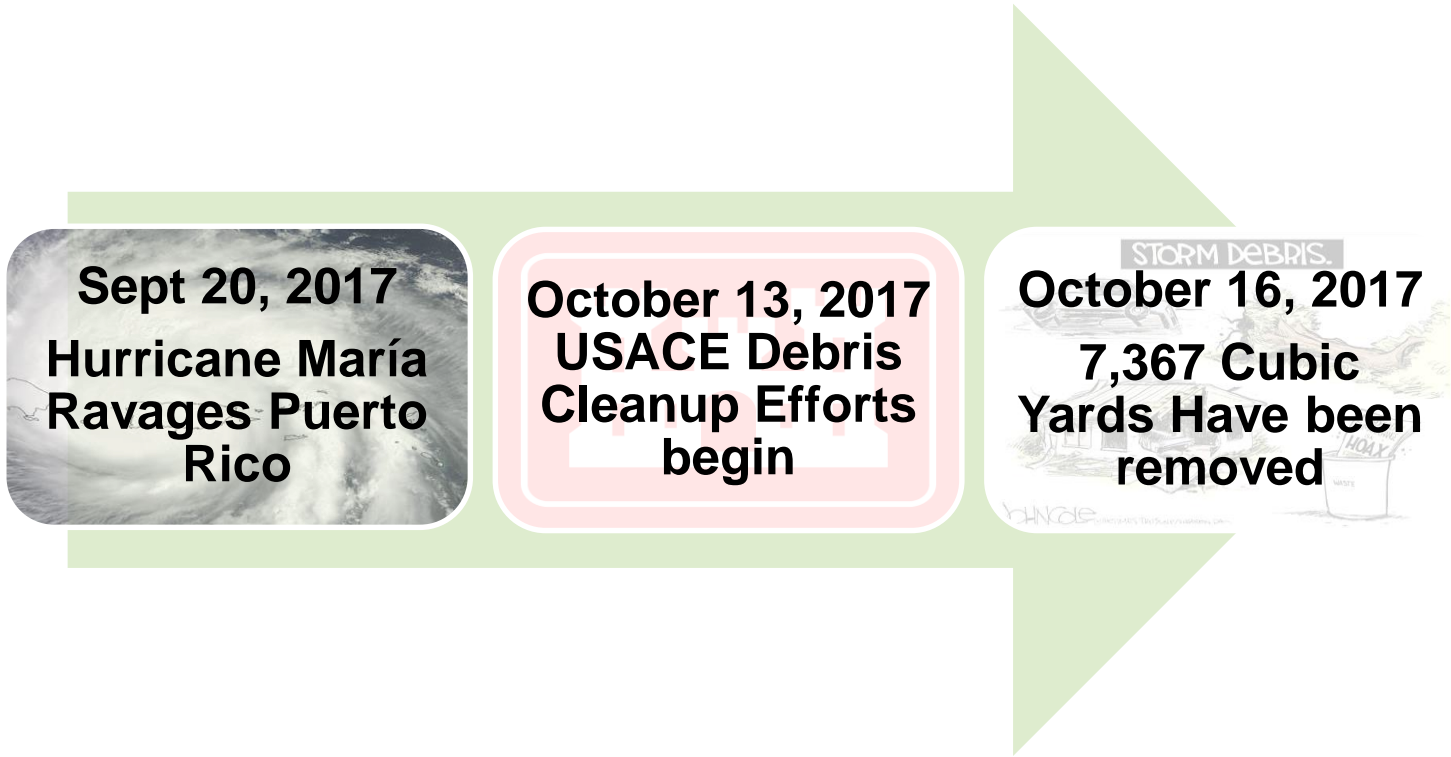


Image Refs.: NASA, USACE, Cagle Cartoons

Post-Hurricane Maria Timeline (cont.)



Image Refs.: CNN, Google Maps, FEMA

Hanna K. Rodríguez Morales, PE, SC | 2018 | AIChE Hurricane Disaster Infrastructure Resilience and Planning Workshop II

Post-Hurricane Maria Timeline (cont.)

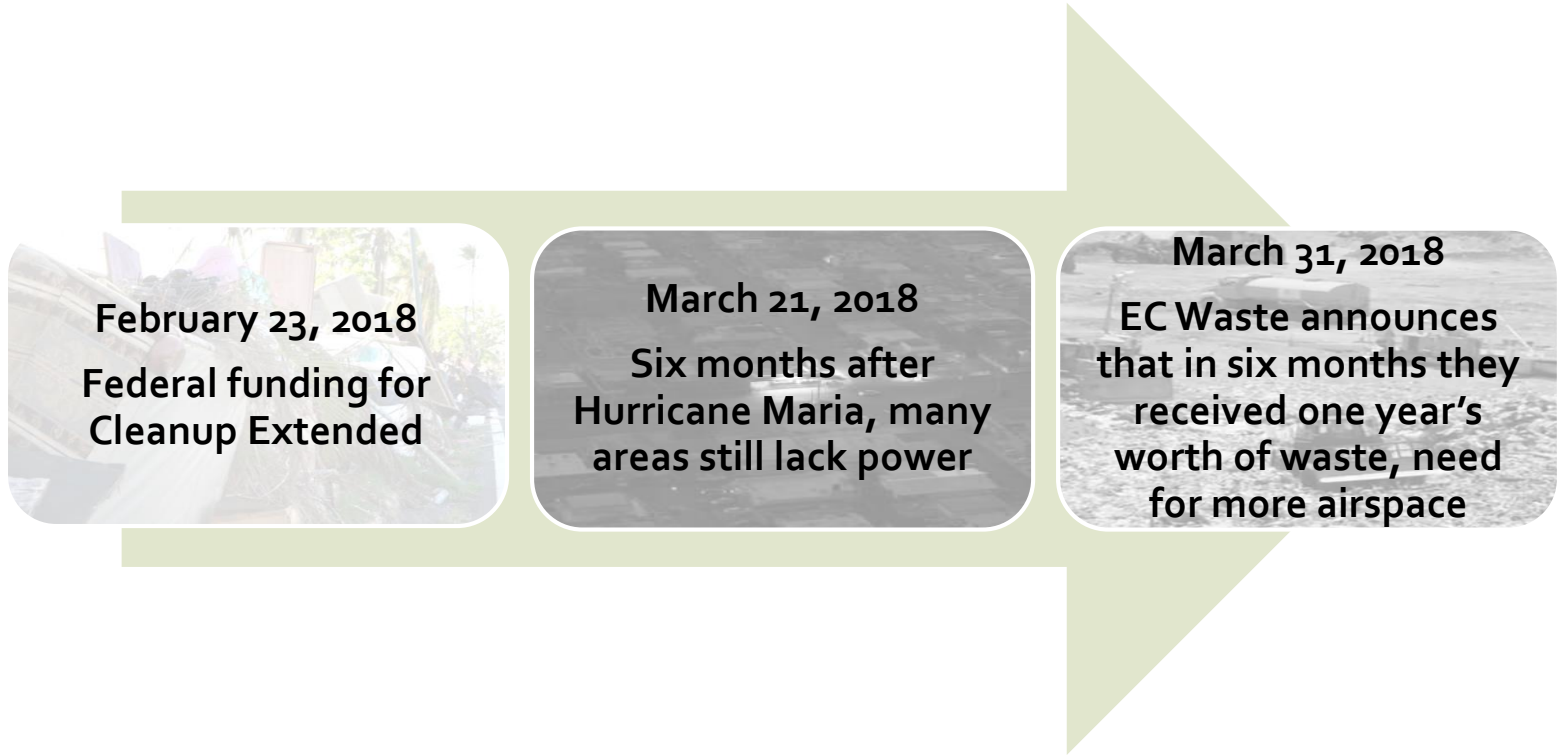
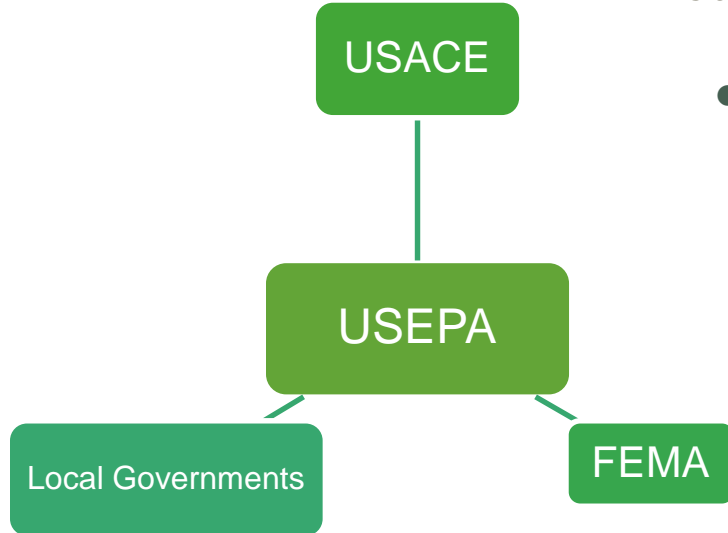


Image Refs.: CNN, Google Maps, FEMA



Household Hazardous Waste (HHW)

January 5, 2018



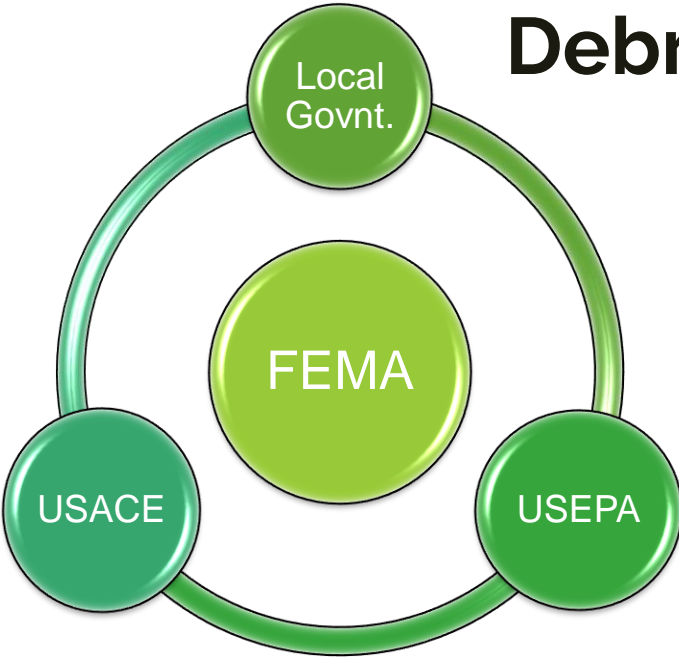
- 130,000 containers of HHW and orphan containers, white goods and e-waste items, have been collected

Ref.: USEPA

Debris & Vegetative Waste

USACE: Recycling metal and wood chips;
November 21, 2017 estimates:

- Wood chipper converting 5,000-6,000 cubic yards per day into Mulch
 - 630,000 cubic yards will be reduced and used for compost, landfill cover and slope protection.
- Close to 9,000 appliances are part of the debris



Sunken or Grounded Vessels



- 377 Vessels
- Over 300 miles
- 1000 Tons of solid vessel waste materials disposed

Flood Control Pumps



Aerial View Juana Matos Community
in September 22, 2017
Ref.: The Guardian

Almost closing



- PRSWA estimates that the powerful hurricane created 6.2 million cubic yards of waste and debris.
- Estimates that at current recycling rates, all of the island's landfills will be full in 20 to 25 years.

Ref.: TICK TOCK by Jodie Howarth
(Haiku Deck)

Don't forget about the US Virgin Islands!
• As of March 3, 2018 736,000 cubic yards of debris had been collected.

Ref.: Latina Media Ventures LLC



New Challenge!

China Waste Import Restrictions

In 2017 and 2018, the Chinese government implemented a series of waste import restrictions limiting or banning a variety of recyclable materials that had previously been accepted for processing.

The restriction of the flow of materials has created new challenges throughout the supply chain of scrap.

Who does this affect?
Residents
Solid waste departments,
Material recovery facilities,
Processors,
End users, and
Beyond.

Ref.: SWANA (<https://swana.org/Resources/ChinaWasteImportRestrictions.aspx>)



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“ The lack of efforts to achieve an ISWM in addition to lack of coordination between the different sectors has truly compromised the effectiveness of WM systems and the industry in the Caribbean. ”

- Ing. Hanna K. Rodríguez Morales Integrated Solid Waste Management Solutions for Puerto Rico: Small, Replicable Steps Towards Achieving Drastic Changes. 2014.

Reimagina Puerto Rico publishes final reports

The Resilient Puerto Rico Advisory Commission published its final reports with actionable and timely recommendations for the responsible use of recovery funds. This focused on rebuilding Puerto Rico in a resilient and sustainable manner; physically, economically, and socially.

All six (6) reports are available in English and Spanish on their website:

<http://www.resilientpuertorico.org>.



A9

Improve the waste management industry to improve metrics gathering, industry data mining and analysis, and fund allocation.

Description

There is a need to improve metrics gathering, industry data mining and analysis, and fund allocation to professionalize and integrate the waste management industry. This action aims at strengthening the ISWM goals⁴⁹. The goals and premises established by these legislative documents are considered sufficient but have since lacked enforcement.

Initial tasks could include:

- Reinforce education stemming from all waste management industry-related stakeholders through certifications and compliance programs.
- Implement proactive professional education or development initiatives, integrating local resources brought together by professional organizations and universities.
- Integrate soft skills into the program for metrics gathering and analysis improvement, which is considered the baseline for ISWM strategy development.

Potential Lead

Puerto Rico Solid Waste Authority

Potential Co-leads

Waste Management Industries, DEOC, EQB, PE Science Trust, Municipalities, Federal and Puerto Rico government agencies

Potential Funding Sources

EPA, FEMA Public Assistance, CDBG-DR, USDA, PI, Municipalities funds are available for professional development

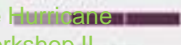
Unmet Needs



Crosscutting Benefits



Timeframe



More info:

<https://www.iemespsc.com/news--information>

References not otherwise noted on slides

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