

Fifth International Symposium on Bioremediation and Sustainable Environmental Technologies

Evaluation of Resiliency of U.S. EPA Superfund Remedies in the 2017 Hurricane Season

April 18, 2019

Carlos Pachon, U.S. EPA Office of Superfund Remediation and Technology Innovation

Raji Josiam, U.S. EPA Region 6

Hilary Thornton, U.S. EPA Region 4

Stephanie Vaughn, U.S. EPA Region 2



<https://www.epa.gov/superfund/superfund-climate-resilience>

Key Concepts Driving Superfund Climate Resilience Actions

Basic Question for the Agency

“How is extreme weather likely to affect the ability of your office to achieve its mission and strategic goals?”

Basic Question for the Remedial Project Manager

“How is extreme weather likely to affect the protectiveness of your remedy, and what should you do about it?”

Superfund Remedial Program 2013 Internal Adaptation 'Action Plan'

Developing a protocol to assess remedy vulnerabilities, and compiling tools and information



Integrating evaluation of extreme weather affects into the existing Superfund process



Developing fact sheets on adaptation at high risk, longer-term remedies



Continuing outreach with legal and enforcement teams to anticipate future scenarios



Holding internal and external training sessions

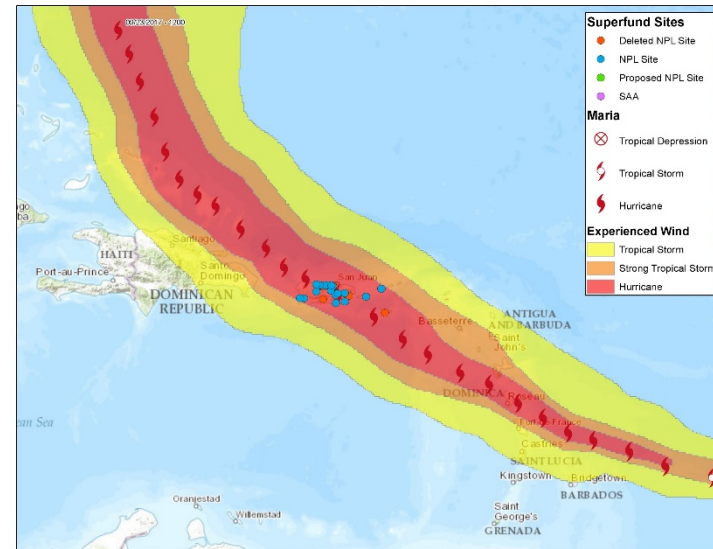
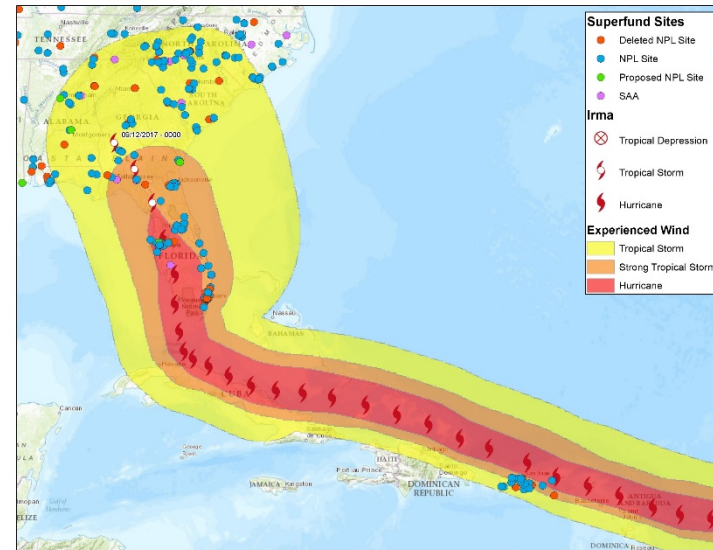
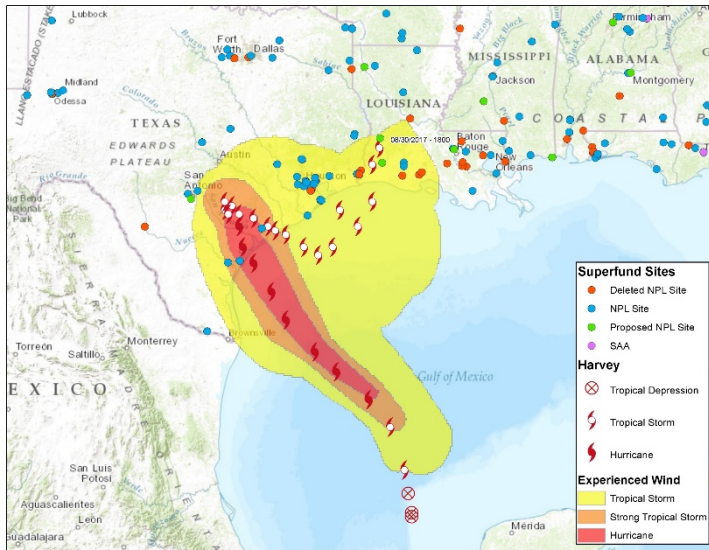


Superfund Climate Resilience Strategy

- Apply climate change and weather science as a standard operating practice in cleanup projects
- Raise awareness of vulnerabilities
 - How a changing climate affects weather at a local level and affects the frequency and intensity of extreme weather events
 - Quantify effects on remedy resilience and site operations, and consider adaptation options that add resilience



2017 Hurricane Season



➔ National Hurricane Center Wind Data for Hurricanes Harvey (top left), Irma (top right) and Maria (bottom right).

2017 Remedy Resiliency Report: Analytical Approach

- ➔ Impact analysis:
 - Map location of all sites relative to floodplains, floodways and flood hazards
 - Use NOAA and FEMA sources to identify sites that were impacted by wind or inundation associated with the hurricanes
- ➔ Damage assessment
 - Review regional reports and seek input from regional POCs
- ➔ Assessment of resilience measures
 - Identify impacted sites that have remedies of higher interest (risk of contaminant mobilization or high replacement cost) and that are in RA phase or with a recent FYR
 - Examine RODs and FYRs for those sites

2017 Remedy Resiliency Report: Overview of Findings

- ↳ Key Finding: The state of the remedies is “Resilient”
- ↳ Analysis of remedies affected by Hurricanes Harvey, Irma and Maria
 - 445 sites located in Regions 2, 4 and 6 were affected by the events
 - 251 sites were exposed to tropical force winds or higher
 - 63 sites experienced flooding (of which 62 saw TF or + winds)
 - 17 sites across the three regions reported minor damage; none at this point indicate impairment to remedy protectiveness
 - Of 42 impacted sites with recent FYRs, 31 reported resiliency design measures or preparedness actions
 - A known issue in Puerto Rico is widespread loss of grid power (now restored)

The U.S. EPA finalized the report in 2018 and subsequently released the report in response to a 2019 FOIA request.

Analysis of 2017 Hurricane Impacts at NPL & SAA Sites: Preliminary Results

Table 1. Summary of flooding and hurricane wind at 252 NPL and SAA sites affected by hurricanes Harvey, Irma and Maria.

FEMA Floodplain Designation	Total # of Sites	Flooded	Total (% by Floodplain)	Wind Force			
				Hurricane	Strong Tropical Storm	Tropical Storm	Below Tropical Storm
100 Year	42	No	27 (64%)	9	7	11	
		Yes	15 (36%)	2	6	7	
500 Year	8	No	6 (75%)	1	2	3	
		Yes	2 (25%)		2		
Floodway	7	No	3 (43%)	1		2	
		Yes	4 (57%)	1		3	
Minimal Flood Hazard	169	No	136 (80%)	27	22	87	
		Yes	33 (20%)	9	18	5	1
Designation Unavailable	26	No	17 (65%)		4	13	
		Yes	9 (35%)		1	8	
Total	252	No	189 (75%)	38	35	116	0
		Yes	63 (25%)	12	27	23	1

Tutu Wellfield

- East-central St. Thomas, VI
- Remedies
 - Groundwater pump and treat
 - Soil vapor extraction complete
- Hurricanes Irma and Maria
 - Hurricane-force winds
 - 5 month power outage caused component oxidation
- Resiliency measures
 - Remedy systems housed in hurricane proof structures with concrete walls and roofs, and steel doors
 - Extraction wells constructed in flood resistant vaults
 - Hurricane proof structures remained intact throughout the storms



Remedial system components

Anniston Army Depot (Southeast Industrial Area)

- ➔ Active US Army installation in AL
- ➔ Remedies
 - Cap of contaminated soil
 - Groundwater pump and treat (active as of 2015 FYR)
- ➔ Hurricane Irma
 - Tropical-storm-force winds
 - No reported damage
- ➔ Resiliency measures
 - Riprap along ditches
 - Alarms to notify operators of faults, and auto shutoff groundwater pumps to prevent tank overfilling



Riprap in ditch near waste pit



Electronic pump control panel

Resilience Integration Along the Superfund Pipeline: ROD Example

San Jacinto River Waste Pits

(Houston, TX)

→ 2017 ROD “Summary of the Rationale for the Selected Remedy” (p. 85):

“The area has a high threat of repeated storm surges and flooding from hurricanes and tropical storms, which if the material was left in place, could result in a release of hazardous substances. Modeling by the U.S. Army Corps of Engineers projects a significant erosion of cap armor, even with the two most robust capping alternatives, as result of combined hurricane and flood conditions.”

“EPA considered several options for addressing contaminated materials at the site. EPA selected a remedy that includes removal of contaminated materials above cleanup levels for the waste impoundments and MNR for the lower contamination level in the Sand Separation Area.”



Resilience Integration Along the Superfund Pipeline: Design & Construction Example

Malone Services Co. Superfund Site

(Texas City, TX)

- ➔ Primary Hazard: Onsite flooding due to hurricane storm surge or sea level rise along Galveston Bay
- ➔ Used NOAA models to analyze storm surge and wave run-up under various hurricane scenarios and predicted sea level rise
- ➔ Constructed an 18-foot-high levee to enclose two waste containment cells completed in 2017
- ➔ Installed armor along vulnerable sides of the cells and the levee
- ➔ Replaced topsoil and hydromulch in cell areas experiencing erosion or washout due to Hurricane Harvey



Photo credit: Geosyntec Consultants

Resilience Integration Along the Superfund Pipeline: Five-Year Review Example

American Cyanamid Superfund Site

(Bridgewater, NJ)

- ➔ Primary Hazard: Onsite inundation due to river flooding
- ➔ 2015 FYR evaluated 2011 Hurricane Irene-related flooding, associated response efforts, and security/access improvements
 - Elevation of critical electrical instrumentation 5' higher than Hurricane Irene flood waters
 - Installation of submersible pumps in bedrock wells to maintain hydraulic control during future floods
 - Reinforcement of earthen berms surrounding two highly contaminated waste impoundments
 - Requirement for future capping systems to be designed to withstand a 500-year flood event



Resilience Measures: Examples of What Is in Place at Superfund Sites

- ➔ Rocky Mountain Arsenal, Commerce City, CO:
 - **Stormwater channel** protecting an onsite hazardous waste landfill cover designed to withstand a 1,000-year storm event
- ➔ Pine Street Canal NPL Site, Burlington, VT:
 - **Weir** at the canal outlet to Lake Champlain, to maintain water depth protecting a remedial sand cap from scour, wave action and erosion damage
- ➔ Van Dale Junkyard, Marietta, OH:
 - **Earth and crushed rock buttress** along a waste cap to stabilize its steep slope and prevent landslides found to correspond with rainfall events
- ➔ Summitville Mine Superfund Site, Summitville, CO:
 - **Predictive snow water equivalent model** to estimate onsite water requiring management each spring due to snowmelt, and associated flow in the nearby Alamosa River during early summers



More Information About Superfund Climate Resilience



Superfund

Superfund Home

Learn About Superfund

Superfund Task Force

Community Involvement

Cleanup Support

Training and Learning Center

Superfund Climate Resilience

Superfund Green Remediation

Superfund Cleanup Optimization

Natural Resource Damages

Superfund Remedial Program in Indian Country

Accomplishments & Benefits

Cleaning up Sites

Contaminants at Superfund Sites

Superfund Climate Resilience

Remedies at contaminated sites may be vulnerable to the implications of climate change and extreme weather events. EPA's Superfund program developed an approach that raises awareness of these vulnerabilities and applies climate change and weather science as a standard operating practice in cleanup projects. The approach involves periodic screening of Superfund remedy vulnerabilities, prioritizing the Superfund program's steps to adapt to a changing climate and identifying adaptation measures to assure climate resilience of Superfund sites.

This Web page shares information about approaches for adapting to climate change and building resilience to extreme weather at contaminated sites undergoing cleanup. This information does not impose legally binding requirements on EPA, states, tribes or the regulated community, and does not alter or supersede existing policy or guidance for the cleanup of contaminated sites. EPA, federal, state, tribal and local decision-makers retain discretion to implement approaches on a case-by-case basis.

Background Information

EPA issued its first policy statement on climate change adaptation in June 2011. It recognized that climate change can pose significant challenges to the Agency's ability to fulfill its mission of

Climate Resilience Information

Information about climate resilience is available

- [Vulnerability Assessment](#)
- [Resilience Measures](#)
- [Adaptive Capacity](#)