(NCR_17) Reduce Coastal Erosion and Provide Disaster Protection Through Beaches and Dunes

Sector(s) Impacted

Natural and Cultural Resources, Economics, Public buildings, Municipalities, various infrastructure

Issue/Problem Being Solved

Coastal dunes were significantly eroded during the 2017 hurricane season. Prior to this, the natural barrier protection provided by the dunes had been weakened by illegal sand harvesting, foot/vehicle traffic, and coastal development.

Additionally, Hurricane Maria reduced beach width and elevation in the majority of beaches in Puerto Rico, significantly increasing coastal flooding risks.

Short Description of COA

This COA would restore Puerto Rico's priority beaches and coastal dunes so that they are stable and resilient to storms and sea-level rise and will protect human life, property, and critical infrastructure on coastal areas. Restored beaches and dunes can support biodiversity and activities such as tourism and recreation, and they would help improve the livelihoods of coastal communities. Activities recommended by this COA include:

- A post-storm beach assessment that measures storm damage, identifies high-erosion areas appropriate for restoration work, and partners with the USACE on a sediment flow analysis.
- Creation of coastal plans and policy that protect both beaches and coastal development and identifies specific restoration actions with community input.
- Beach and dune restoration activities, including installation of biomimicry sand accretion systems, exclusion fencing, wooden boardwalks, information signs, planting of dune vegetation to strengthen the dunes, development of sand management plan that include sand relocation programs for displaced sand, and the an efficient law enforcement action plan to reduce illegal sand extraction, and an outreach and environmental education program to increase community involvement and buy-in.
- Creation of a clearly identified and consistently applied permitting process for dune and beach restoration

In the short term, this COA can help prevent coastal flooding and reduce beach erosion from both seasonal and disaster related events; since dunes and beaches take time to reestablish benefits would increase over the long term.

Potential Benefits

Restored beaches and dunes will increase coastal resilience and hazard mitigation by providing protection to coastal public and private infrastructure, human safety, health and commerce from coastal hazards such as erosion and flooding that take place due to weather events such as hurricanes, storm surges, and seasonal weather events. Restoring and managing the dunes and beaches will also provide other benefits such as promoting the ocean economy related recreation and tourism as well as provide habitat protection to endangered species, such as sea turtles.

Potential Spillover Impacts to Other Sectors

Ocean economy development opportunities, human safety, public buildings, infrastructure, tourism and recreation.

Potential Costs

Dune restoration: On-the-ground ecological restoration activities: $2.1-$4 million. Management planning $540-$900 thousand (for 9 municipalities). Environmental education component: $100,000. Minimal funding will be required for long-term maintenance and repairs.

Beach restoration: Debris removal and disposal will take up to two years and cost an estimated $75 million, with interventions at San Juan metro area beaches estimated at $52M and Rincon beach restoration at $20M. A USACE regional sediment budget has been funded already at $3 million.

These costs could be lower if NCR 33 (BlueShore Workforce Development) COA is implemented and provides the labor.

Potential Funding Mechanisms

FEMA Hazard Mitigation Grant Fund (404 funds), USFWS Coastal Program, and National Fish and Wildlife Foundation, USACE, DOI, NOAA, CDBG

Potential Pitfalls

Law enforcement is not sufficient to prevent illegal sand extraction and illegal all-terrain vehicle traffic. Rangers lack understanding/education and impede efforts by requiring special permits.

Beaches are dynamic systems with natural waxing and waning cycles. Restoration efforts should be focused on those beaches in accretion cycles, or efforts and money may be wasted on inappropriate restoration. Inappropriate restoration projects will “steal” sand from neighboring areas, which may cause unintended damages. Future storms could erode restoration efforts.

Likely Precursors

Cleanup of storm debris, such as marine debris, broken tree branches, and sand fencing. Sedimentation studies must be done first. Beach restoration will be most successful in conjunction with coral reef and seagrass restoration projects. Policies should promote healthy beaches and resilient coastal development.

Note: It is recommended that coral reefs/seagrasses, beaches/dunes and wetlands are restored in tandem. While each of these systems is technically a separate ecosystem, the benefits for coastal protection, biodiversity and commercial fishing, and recreation are all increased if all three systems are healthy and functional. When considering coastal protection, for example, wetlands provide water filtration services which help keep corals and seagrasses healthy; healthy corals and seagrasses are larger and denser and provide more wave attenuation, thus protecting wetlands from storm damage. Tourism is improved if tourists can expect to enjoy intact beaches, wildlife on live reefs and seagrass beds, and healthy bioluminescent wetlands all on the same trip. These three systems work in symbiosis and there are many benefits that are multiplied if restoration to these three systems is done simultaneously.

Beach and dune systems are interrelated and should be restored in tandem, however, the restoration processes are different. Therefore the justifications for dune restorations in this document appear first, and justifications for beach restoration and coastal erosion mitigation appear second.

Dunes COA Justification

Sector(s) Impacted

1. Infrastructure (roads, commercial buildings, houses, public buildings)
2. Economic Recovery (business, tourism)
3. Municipalities
4. Wetlands
5. Health & Social Services
6. Community Planning and Capacity Building

Issue/Problem Being Solved

What specific issue is this CoA impacting

Coastal dunes were eroded during the 2017 hurricane season and the 2018 north-easterly swells.

Before the storm season, coastal dunes were already weakened due to illegal sand harvesting, foot/vehicle traffic and coastal development. Dunes act as a natural barrier to protect the inland from coastal erosion and flooding caused by storm swells, but they were less effective during the 2017 storm season due to degradation. The 2017/2018 storms further damaged this ecosystem, and in order to recover this coastal barrier, sand dune restoration must take place, together with the development of a long term sand management plan.

Short Description of CoA: CoA Name (few word description)

What does the CoA do?

Ecological restoration, monitoring and maintenance of sand dunes on the north coast of Puerto Rico.

Who is implementing the CoA?

- NGOs operating along the coast
- Fish and Wildlife Services
- DNER (authorization)
- FEMA strategic communications for outreach/educational purposes
- NOAA Office for Coastal Management
- Social media outlets
- Local community volunteers/schools
- Blue Shore Workforce (COA_33)
- Municipalities

How are they implementing the CoA?

1. Dune restoration
   - Installation of biomimicry sand accretion systems and exclusion fencing
   - Planting of dune vegetation to enhance dune strength and avoid sand movement due to weather events (e.g,. strong winds and waves).
   - Installation of wooden boardwalks to allow access to the beach and coast without impacting the dune
   - Installation of information signs
   - Maintenance of boardwalks

2. Development of municipal sand management plans and programs that include the implementation of sand relocation programs to manage displaced sand. These will enhance the island-wide Sediment Management Plan being funded via supplemental USACE funds.

3. Development and implementation of an efficient law enforcement action plan (DNER/USFWS) to reduce illegal sand extraction.

4. Development and implementation of an outreach and environmental education program to increase community involvement and buy in.

5. Increase the permitting process for dunes and beach restoration so that it's clearly identified and consistently applied. Clearly identified and consistently applied permitting process for dunes and beach restoration.

What is the likely time scale to see benefits?

At least 24 months for short term benefits and 5 years long term.

In the short-term this COA can help prevent coastal flooding and start the development cohesive sand management plans for the municipalities affected. Dunes take time to re-establish (1 meter per year under best conditions). Benefits will increase over the long term.

Location (if any) of CoA.

The following table are the specific restoration actions proposed for each location.

Table XX: Locations with COA recommendations by site

		Restoration Actions						
Location	**Site Name**	**Board-walk or wooden walk-ways**	**Vegeta-tion planting**	**Fencing/barriers**	**Relo-cate displaced sand**	**Law enforcement**	**Biomi-micry**	**Educa-tional signs**
Isabela	Barrio Bajuras (Pedro Albizu Campos St.)	x	x	x	x	x	x	x
	Barrio Bajuras (Monte de Oca St.)	x	x	x	x	x	x	x
	Golondrinas Beach	x	x	x	x	x	x	x
	Haudimar Beach	x	x	x	x	x	x	x
	Western part of Secret Spot Beach		x	x	x	x	x	x
	Eastern part of Secret Spot Beach	x	x	x	x	x	x	x
	Middles Beach	x	x	x			x	x
	Breach in Middles Beach		x	x	x	x	x	
	East of Middles Beach		x	x	x	x	x	
	Poza de Teodoro		x	x	x	x	x	
	Shore Island	x	x	x	x	x	x	x
	Pozo Brujo	x	x		x	x	x	x
Camuy	Villa Pesquera	x	x	x	x	x	x	
	Finca Nolla Nature Reserve	x	x	x	x	x	x	x
Hatillo	Urbanización Costa Norte	x	x	x	x	x	x	x

		Restoration Actions						
Location	**Site Name**	**Board-walk or wooden walk-ways**	**Vegeta-tion planting**	**Fencing/barriers**	**Relo-cate displaced sand**	**Law enforcement**	**Biomi-micry**	**Educa-tional signs**
Arecibo	Jarealito	x	x		x		x	
	Maranto	x	x	x	x	x	x	
Loiza	Road PR-187	x	x	x	x	x	x	x
Manatí	Poza de las mujeres	x	x	x		x	x	
	Mar Chiquita	x	x	x	x	x	x	x
Dorado	El Caracol	x	x	x	x	x	x	x
	El Único	x	x	x	x	x	x	x
Luquillo	CEN		x	x	x		x	
San Juan	Ocean Park	**TBD**	**TBD**	**TBD**	**TBD**	**TBD**	**TBD**	**TBD**
	Totals	18	23	22	21	20	23	8

Note: A formal assessment was not been carried out for Ocean Park due to the timeline of the development of the COAs. However, NOAA OCM and DNER have documented the erosion of the dunes, which is are causing direct impact on the storm water pump stations since sand is being washed inland into water drains.

Source: Mayer, Robert J., Soto-Calvente, Erik J., Martir-Vargas, Heriberto, Rodríguez-Sosa, Alvin G., Bonet-Muñiz, Sheila M., Cabañas-Ramos, Nichole a., Mayer, Robert B. "Coastal Dune and Erosion Assessment of the North Coast of Puerto Rico: Final Report DOI-FEMA Natural and Cultural Resources, Recovery Support Function (NCR RSF)" *Universidad de Puerto Rico en Aguadilla, Vida Marina: Centro de Conservación y Restauración Ecológica Costera.*

Goals of the COA are to:

- Reduce foot traffic on sensitive parts of dunes in the targeted municipalities of San Juan, Isabela, Camuy, Hatillo, Arecibo, Manatí, Vega Baja, Dorado and Loiza by at least 50% by 2020.
- Decrease the incidence of illegal sand extraction by at least 60% in hot spots of this activity along the sensitive parts of dunes in the targeted municipalities by 2020.
- Increase the vegetative cover of restored coastal dunes in the targeted municipalities by at least 40% by 2020.
- Increase the volume of dunes using sand barriers and biomimicry matrices in areas of the dunes being restored by at least 0.80% per dune per week in exposed areas and 0.2% per dune per week in sheltered areas of the targeted municipalities by May 2020.
- Increase community involvement and buy-in for beach and dune restoration and to help with maintenance efforts in at least 1 community per each of the targeted municipalities by 2020.
- Relocate at least half of the total amount of sand that has accumulated in the areas of sand dunes (outside the beach) impacted by the recent storm and swell events.

The USACE Regional Sediment Management Study may identify additional priority sites, as well as potential actions such as developing community or municipal guidelines or best practices for dealing with sand movement resulting from storm events.

Potential Benefits

A brief description of how the CoA will impact the issue together with estimates of the benefits (qualitative or quantitative).

Implementing the CoA will provide storm protection, habitat and beach access to residents and tourists.

Potential Spillover Impacts to Other Sectors

Brief description on how the CoA could positively or negatively impact other sectors, with attention to considerations for implementation

In addition to the sectors listed on the first section of this document the following sectors could also be impacted: tourism (e.g. surfing) and public buildings and infrastructure. It can also be expected that sea turtles (a federally protected species) would benefit from habitat restoration as well as a reduction in light pollution.

Potential Costs

Ecological Restoration On the Ground Activities - $2.1-4 million

Management Plans for 9 municipalities – $540,000-900,000
Environmental Education Component - $100,000

There will be minimal funding required for long term maintenance and repairs.

Note: Labor costs will be lowered if Blue Shore (NCR_33) is implemented.

Potential Funding Mechanisms

Federal (specific agency and program is best), commonwealth, private sector, … sources that could be used to fund the CoA

404 funds (Hazard Mitigation)

Fish and Wildlife

US. Fish and Wildlife Service Coastal Program and National Fish and Wildlife Foundation.

DNER’s Coastal Zone Mangaement Cooperative Agreement with NOAA’s Office for Coastal Management

NFWF

NOAA’s Resilience Grants

Potential Pitfalls

Insufficient law enforcement for the prevention of illegal sand extraction and illegal all-terrain vehicle traffic.

Rangers lack understanding/education of restoration actions and impede efforts by requiring special permits.

Current efforts have limited staff and vehicles.

Likely Precursors

Cleanup of storm debris such as marine debris, broken tree branches and sand fencing.

Coastal Erosion COA Justification

Sector(s) Impacted

1. Infrastructure
2. Public buildings
3. Economics
4. Municipalities

Issue/Problem Being Solved

Hurricane María reduced beach width and elevation in the majority of beaches in Puerto Rico, significantly increasing coastal flooding risks and affecting recreation.

Short Description of CoA: CoA Name (few word description)

What does the CoA do?

Restore the beaches and coastal dunes of Puerto Rico so that they are stable, resilient to storms and sea level rise and will protect human life, property and critical infrastructure on coastal areas. They will support biodiversity, activities such as tourism and recreation, and will help improve the livelihoods of coastal communities in the 44 coastal municipalities of the island.

Post-storm beach Assessment

1. Map and quantify pre (March 2017) and post storm (September 2017) shoreline changes by municipality level for the entire island.
2. Identify beaches with high and severe erosion by municipality level based in the assessment.
3. Identify and select the eight (8) coastal sites that would be appropriate for restoration.
4. Identify the location of sediment displaced by the storm in the selected coastal sites; if appropriate, plan to relocate sediment. This action is specifically targeted at locations where roads were cleared of sand post-storm and the sand was removed to the landside, rather than the beach side of the road. This does not refer to large scale renourishment efforts.
5. Assess benthic conditions (natural barriers) after storm in the selected sites.
6. Communicate assessment results with local governments.
7. Conduct regional sediment management studies to prioritize beach restoration efforts. Note: the Army Corps of Engineers is expected to perform a long term sediment flow assessment within the next five years.
8. Monitor coastline for post-restoration changes.

Coastal Planning and Policy

1. Insert the information of the post-storm condition of the beach in the “Plan de Ordenacion Municipal” (POT) for use as a planning indicator.
2. Delineate and inform administrative protocols to deal with beaches in critical erosion (federal, state and municipality level).
3. Design custom-made planning and recovery coastal intervention for beaches with major sediment losses based in study findings (short and long term).
4. Recommend bills (both state and municipality levels) that create strategies that contribute to reduced beach erosion, increase beach protection and execute coastal adaptation and resilience.
5. Include community members in the local coastal planning and decision-making processes.

Beach width and elevation restoration

1. Enhance natural coastal barriers (dunes, coral reefs, seagrass beds and beach rock) where appropriate.
2. Recover the sand loss moved during storm events.

3. Remove coastal debris.
4. Evaluate the relocation of the infrastructure identified in coastal flooding high risk areas. The evaluation will be conducted by a group that includes community members, municipality and state parties.

Time scale: within the next 3-5 years.

Potential Benefits

Benefits of completing this COA include:

- Increased beach area for recreation
- Increased tourism draw
- Increased storm protection
- Habitat creation and protection for beach and coastal species, including sea turtles

Potential Spillover Impacts to Other Sectors

Brief description on how the CoA could positively or negatively impact other sectors, with attention to considerations for implementation

Beach conservation and restoration will reduce future storm impacts, which will support infrastructure and the local economy. The tourism and recreation associated with healthy beaches will improve coastal community livelihoods and economic opportunities.

Potential Costs

Debris removal and disposal will take up to two years--$75 million. This is an estimate using the amount of coast that is desired to be restored using previous work in Road 187, which was carried out with the USACE.

Regional sediment budget study has been funded up to $3 million and will be performed by the USACE.

Note: Labor costs will be lowered if Blue Shore (NCR_33) is implemented

Potential Funding Mechanisms

USACE, DOI, NOAA, USFWS, 404 funds, CDBG grants

Potential Implementers:

PR Department of Natural and Environmental Resources (DNER), US Army Corp of Engineers (USACE), municipalities

Potential Pitfalls

Beaches are dynamic systems with natural waxing and waning cycles. Restoration efforts should be focused on those beaches in accretion cycles or efforts and money may be wasted on inappropriate restoration.

Inappropriate restoration projects will “steal” sand from neighboring areas, which may cause unintended damages.

Future storms could erode restoration efforts.

Likely Precursors

Sedimentation studies are critical before restoration plans begin because when sand accretes in one area, it is generally eroding from a nearby area.

Beach restoration will be most successful in conjunction with coral reef and seagrass restoration projects, as reefs and seagrasses provide at-sea wave attenuation and will minimize wave energy that causes erosion.

Policy should be made in the following areas:

- Coastal construction zones. Careful consideration of future storm damage and sea level rise before coastal development is approved.
- Buy-outs to preserve/restore lands, ensure tsunami evacuation zones: Develop policies to establish development rights for land lots and houses that have been completely destroyed. Enable appropriate entities to demolish structures and develop into open spaces.
- Private property debris removal