DRAFT

PRIMARY RESTORATION PLAN AND ENVIRONMENTAL ASSESSMENT FOR THE 2006 T/V MARGARA GROUNDING GUAYANILLA, PUERTO RICO

T/V MARGARA aground with tugs alongside on April 27, 2006. Photo courtesy of Puerto Rico Department of Natural and Environmental Resources

Prepared by:

The Puerto Rico Department of Natural and Environmental Resources
and
the National Oceanic and Atmospheric Administration

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1.0 INTRODUCTION: PURPOSE OF AND NEED FOR RESTORATION

1.1 DESCRIPTION OF THE INCIDENT & RESPONSE ACTIVITIES

On or about April 27, 2006, the T/V MARGARA , a 228-m (748-ft) Cayman Islands-flagged tanker, went aground on a hard bottom formation three miles south of Tallaboa, Puerto Rico, in waters approximately 10.5 m (34 ft) in depth (Figure 1). The vessel was carrying over 300,000 barrels of #6 fuel oil. The vessel was ultimately refloated and removed from the grounding location on April 28, 2006 without discharging oil into the environment. However, the response efforts to refloat and remove the vessel in an effort to prevent an oil spill moved the vessel a considerable distance and caused impacts to the sea floor at multiple locations.

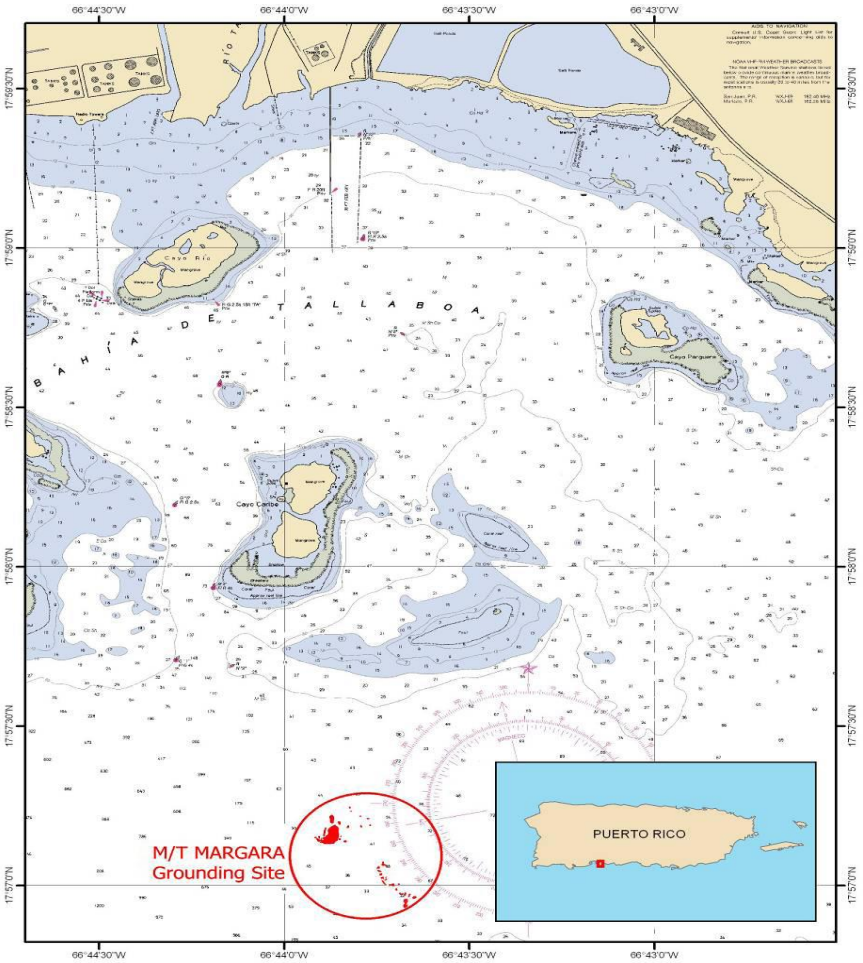

Figure 1: T/V MARGARA grounding site relative to Bahía de Tallaboa in southern Puerto Rico.

The general path of the vessel is shown in Figure 2. The vessel initially grounded in the eastern portion of the southern impact site (Location #1) and during response actions was rotated 90 degrees and westward moving it further into the southern impact site (Location #2). The nature of this response-related movement makes it not possible to separate the impacts from the initial grounding from the response/removal damage, but it is clear that impacts in Location #1 were exacerbated as a result of the movement. After the vessel came to rest in Location #2 the decision was made by the Captain and the FOSCR to attempt to free the vessel using a combination of vessel power and tug assist. This response

operation did free the vessel for a short period of time but resulted in a wide area of prop-wash damage (Location #3) before the vessel was accidently re-grounded in Location #4, the northern impact site. Emergency attempts to free the vessel and prevent an oil spill caused rotation and movement over a large continuous reef area within the northern impact site. Eventually the vessel was freed from Location #4 and subsequently impacted a series of smaller reefs in Location #5 before being moved to deeper water. Sporadic damage resulting from the propwash of the T/V MARGARA and/or assisting tug boats was also evident at multiple locations.

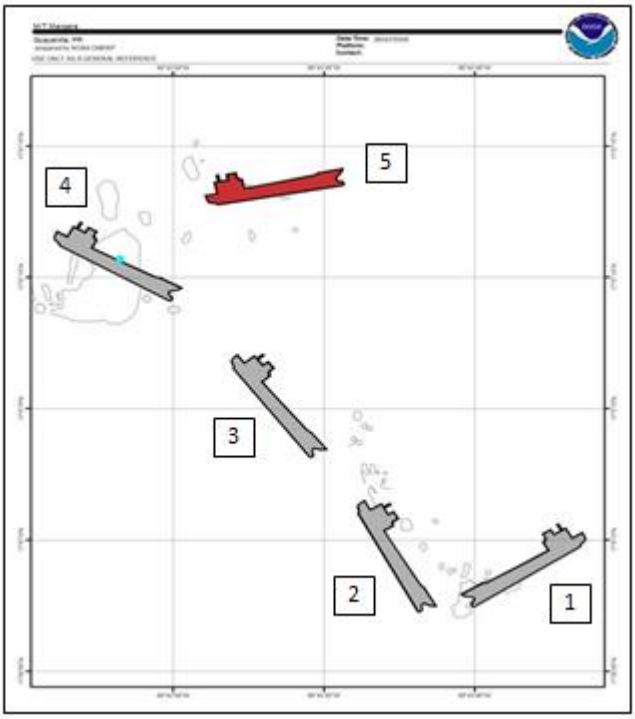

Figure 2: T/V MARGARA path during removal with coral reef impact areas outlined in the background. Location #1 indicates the initial grounding site. Location #2 shows how the vessel was rotated during removal causing additional damage in the southern impact. Locations #3-5 show the path of the vessel after it was freed and subsequently re-grounded in the northern impact area.

The T/V MARGARA Incident caused significant injuries to coral resources, other reef biota, and reef habitat over a large area (Figure 3). The T/V MARGARA impact site can be separated into a southern impact site (~ 1,204 m^2 of reef impacted), a northern impact site (~ 5,530 m^2 of reef impacted), and a deeper central area impacted by prop wash (~ 174 m^2 of reef impacted). The grounding of the vessel, its subsequent movement and actions undertaken to remove the vessel in order to prevent a significant oil spill caused or contributed to 6,908 m^2 of damage to the sea floor. Within that area, an estimated 6,393 m^2 of reef suffered a complete loss of biota. The remaining 515 m^2 suffered partial resource mortalities.

Emergency restoration actions were undertaken at the site between 2006 and 2008. These efforts included creating numerous individual installations or small modules, with dislodged reef framework and corals attached or embedded using a cement mixture. These installations were anchored with varying lengths of rebar driven into the generally unconsolidated substrate. These actions were able to save approximately 10,500 corals and to address some of the restoration needed at the site to avoid further losses (albeit with varied success). These prior emergency restoration actions, however, were not intended nor designed to address all potential restoration actions that might be needed at the site. A more detailed description of the emergency restoration actions undertaken at the site is included in Appendix A.

Monitoring to assess coral recruitment and survival at the site was initiated in 2008 to evaluate recruitment and recovery in the rubble fields, in consolidated hard substrate areas, on restoration structures and in the surrounding un-impacted reef. Data from this effort have shown little to no recruitment survival in the large areas of unconsolidated rubble areas seven years post-grounding. Recruitment survival in the rubble fields is significantly lower compared to areas with prior emergency restoration actions and un-impacted reef.

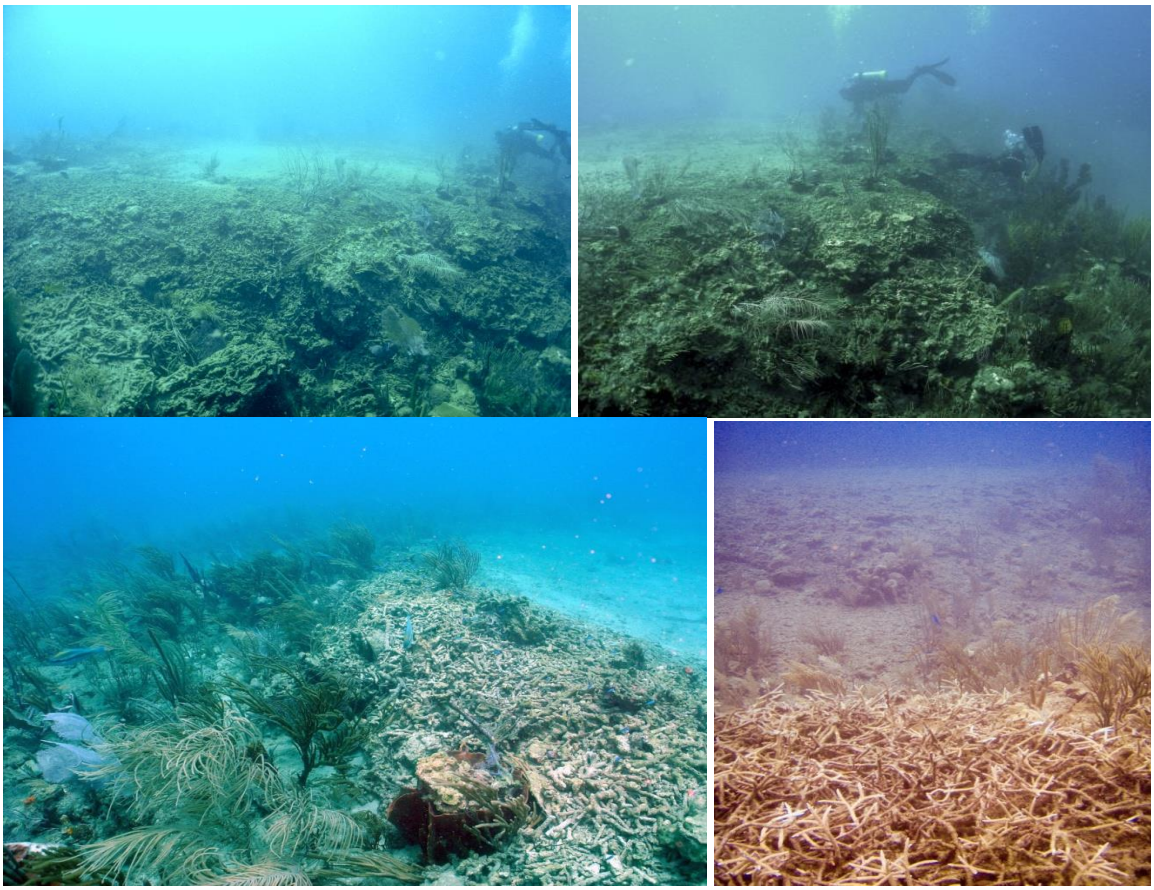

Figure 3: Photos of impacted areas and adjacent reef at the T/V MARGARA site. Photos taken by NOAA Restoration Center in 2006.

1.2 PURPOSE AND NEED

The purpose and need for restoration in the aftermath of the T/V MARGARA Incident is two-fold: (1) to restore the affected area and injured resources (primary restoration) and (2) to provide restoration to compensate for interim losses to the coral reef ecosystem (compensatory restoration).

The restoration proposed under this Draft Primary Restoration Plan and Environmental Assessment (Draft PRP/EA) is intended to address the first of these purposes, i.e., to ensure the affected area is restored through the recovery of resources and services at the site (primary restoration). The additional restoration needed to compensate for the interim losses to the coral reef ecosystem will be proposed in a future compensatory restoration plan, after this primary restoration plan is finalized.

Prior to the T/V MARGARA grounding, the impacted reef site was topographically complex, with high and low relief areas providing habitat to multitudes of fish and marine invertebrates. After the grounding, the majority of the site was left at uniform level with very little or no topographic complexity within individual impact areas. The original topographic complexity in these areas will not recover without active re-introduction of a more complex topographic structure. Further, the Incident resulted in areas with large amounts of loose, unstable rubble[1] that is vulnerable to movement during high energy events (i.e., storms). Movement of this rubble is continuing to cause injuries and losses of coral resources and other benthic biota at the site and impeding the ability of the reef to recover through natural recruitment processes. Stabilization of these rubble areas is essential in order for the impacted areas to recover. Without stabilization of these areas, recovery may never occur. The Puerto Rico Department of Natural and Environmental Resources and the National Oceanic and Atmospheric Administration have determined that additional structural stabilization and restoration actions are needed to provide a meaningful opportunity for and to accelerate natural recovery of the injured resources and habitat at the T/V MARGARA site.

The primary restoration actions proposed in this Draft PRP/EA are intended to address the site conditions that are impeding the recovery of resources and services at the T/V MARGARA site. The actions proposed would restore topographic complexity of the reef, increase coral recruitment survival to accelerate coral reef recovery, enhance coral cover at the site and stabilize the rubble areas to prevent additional damage to reef resources during storm events. The actions proposed for implementation include all activities appropriate to the planning, design, construction, monitoring, oversight and evaluation of restoration performance

In keeping with the focus of this plan, this Draft PRP/EA provides summarized information regarding:

- the environmental consequences of the T/V MARGARA Incident, including the affected environment,
- the objectives of primary restoration at the T/V MARGARA grounding site;
- the restoration alternatives considered for meeting these objectives in developing this proposed plan
- the monitoring that would be needed to determine the success of the proposed primary restoration actions.

This document also serves, in part, as the Trustee agencies' compliance with the National Environmental Policy Act (NEPA), 42 U.S.C. § 4321 *et seq.*, as applicable to restoration planning.

1.3 NATURAL RESOURCE TRUSTEES AND AUTHORITIES

This Draft PRP/EA) has been developed by the Puerto Rico Department of Natural and Environmental Resources (PRDNER) of the Commonwealth of Puerto Rico and the National Oceanic and Atmospheric Administration (NOAA) of the United States Department of Commerce.

PRDNER and NOAA each act as a Natural Resource Trustees pursuant to the Oil Pollution Act of 1990 (OPA), 33 U.S.C. §§ 2701 *et seq.*), the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 C.F.R. § 300.600, Executive Order (EO) 12777, 56 Fed. Reg. 54757 (Oct. 18, 1991). As a Trustee, each agency is authorized to act on behalf of the public to assess and recover natural resource damages for the natural resource injuries and service losses caused by the T/V MARGARA Incident,

[1] This rubble is primarily relic *A. cervicornis* fragments that were exposed when the reef framework was compromised as a result of the Incident.

including the costs to plan and implement actions to restore natural resources and resource services injured or lost as a result of the Incident.

PRDNER has further authority to address the harm caused by this Incident pursuant to Law 147 of the Commonwealth of Puerto Rico (Law 147). Law 147 provides for the protection, conservation and management of coral reefs in state waters. The Act empowers the DNER Secretary to take the needed strategies to grant such protections and conservation, including the establishment of agreements that will promote the achievement of the purposes of the Law. It also empowers the Secretary to take all needed actions against parties responsible for vessel groundings in order for them to repair the damage inflicted to the system and restore the reef.

PRDNER is serving as the Lead Administrative Trustee (LAT) for coordinating the natural resource damage assessment for the Incident. NOAA is the federal lead trustee for purposes of NEPA compliance. Hereafter, PRDNER and NOAA are collectively referred to as "the Trustees".

In developing this plan, the Trustees have acted in accordance with the natural resource damage assessment regulations issued pursuant to OPA. These regulations are set forth at 15 C.F.R. Part 990 (hereafter, "NRDA regulations"). The restoration alternatives considered, and the restoration actions proposed in this plan, were identified and evaluated based on technically valid, reliable and cost effective methods, and based on the technical expertise and restoration experience of the Trustees and information provided by other scientists and experts consulted.

1.4 DETERMINATION SUPPORTING DEVELOPMENT OF THIS RESTORATION PLAN, 15 C.F.R. 990.40-.45 (SUBPART D)

The Trustees issued a Notice of Intent to Conduct Restoration Planning (NOI) for this Incident on March 6, 2013**.** That Notice was posted to http://www.drna.gobierno.pr/oficinas/arn/recursosvivientes/negociado-de-pesca-y-vida-silvestre/division-de-recursos-marinos-1/ and also published in *Primera Hora* on April 19, 2013. That Notice documented the Trustees' determination to proceed with development of a formal restoration plan for this Incident, in accordance with the provisions of 15 CFR §§ 990.42 and .44, and that such planning would address the need for both further primary restoration actions at the site as well as the type and scale of restoration actions that are needed and appropriate to compensate the public for additional resource injuries and losses. Since the choice of primary restoration will affect the determination of the recovery period for the interim losses and the amount of compensatory restoration required, a separate compensatory restoration plan will be developed after the primary restoration plan is finalized.

1.5 NATIONAL ENVIRONMENTAL POLICY ACT

The National Environmental Policy Act (NEPA), 42 U.S.C. § 4321 *et seq*, and the regulations guiding its implementation at 40 C.F.R. Part 1500, apply to restoration actions that federal natural resource trustees plan to implement under OPA and other federal laws. NEPA and its implementing regulations outline the responsibilities of federal agencies under NEPA and provide specific procedures for preparing the environmental documentation necessary to demonstrate compliance with NEPA. Generally, when it is uncertain whether a contemplated action is likely to have a significant effect on the quality of the human environment, federal agencies will begin the NEPA planning process by preparing an Environmental Assessment (EA). The EA may undergo a public review and comment period so that federal agencies may consider public input prior to making a determination. Depending on whether an impact is

considered significant, the federal agency will either develop an environmental impact statement (EIS) or issue a finding of no significant impact (FONSI).

The Trustees have integrated the OPA and NEPA processes in this Draft PRP/EA. Integration of the EA into this document allows the Trustees to provide for public involvement under both statutes concurrently. This approach is recommended under 40 C.F.R. § 1500.2(c), which provides that federal agencies should "[i]ntegrate the requirements of NEPA with other planning and environmental review procedures required by law or by agency practice so that all such procedures run concurrently rather than consecutively." Thus, this document serves, in part, as the agencies' compliance with the National Environmental Policy Act (NEPA).

This Draft DARP/EA complies with NEPA by 1) describing the purpose and need for restoration action in Section 1.0, "Introduction: Purpose and Need for Restoration"; 2) summarizing the current environmental setting in Section 2.0, "Affected Environment"; 3) identifying alternative actions and analyzing potential effects in Section 4.0, "Primary Restoration Plan - Alternatives Considered & Proposed Actions"; and 4) addressing public participation in this process in Section 1.7, "Public Participation".

1.6 COORDINATION WITH THE RESPONSIBLE PARTY

The NRDA regulations under OPA require trustees to invite the responsible party ("RP") under the statute to participate in the natural resource damage assessment process. Although an RP may contribute to the process in many ways, the authority to make determinations regarding injury and restoration rests solely with the Trustees.

The RP for the T/V MARGARA Incident is Ernst Jacob (GmbH & Co KG). The RP was invited to participate in the conduct of emergency restoration, as provided in 15 CFR § 990.14(c), and did cooperate with the Trustees by performing and/or funding of emergency restoration actions. The RP has cooperatively participated in natural resource damage assessment activities beyond the emergency restoration phase as well. This cooperation and coordination between the parties has helped avoid duplicative assessment activities, allowed for timely information sharing, allowed for joint field efforts and discussions among the parties' technical representatives, and has made the process more cost-effective. Input from the RP has been considered by the Trustees in development of this Draft PRP/EA.

1.7 PUBLIC PARTICIPATION

Section 1006(c)(5) of OPA requires the Trustees to involve the public in the restoration planning process (33 U.S.C. 2706(c)(5)). The NRDA regulations interpret this provision as requiring that Trustees provide the public with the opportunity to comment on proposed restoration plans, and that any public comments received be considered prior to adopting a final plan (15 C.F.R. Section 990.55(c)). The Trustees believe that public involvement and input is essential to an effective restoration planning process. Affording opportunity for public comment is also consistent with all applicable state and federal laws and regulations, including NEPA and its implementing regulations at 40 C.F.R. Parts 1500-1508.

The NOI published on March 6, 2013 served to first inform the public of the Trustees' intention to develop a formal restoration plan for the T/V MARGARA Incident, including to address the need for further primary restoration at the site. The NOI identified the grounding event and the Trustees involved, provided general information on the natural resource injuries and losses for which restoration

might be required, and identified some types of restoration that were thought to be feasible based on discussions with various representatives of the public including the Commonwealth, local governments and institutions, private organizations, academic experts, and RP representatives. The Trustees have used information from these discussions in developing this Draft PRP/EA and in identifying the primary restoration actions proposed herein.

The Trustees are making this Draft PRP/EA available for 30 days to afford the public an opportunity to review and comment on the proposed primary restoration plan for the T/V MARGARA site. The Trustees will consider comments received during the public comment period before adopting a Final PRP/EA selecting primary restoration actions for the T/V MARGARA site. A summary of the comments received, and the Trustees' responses thereto, will be included in the Final PRP/EA. The Trustees will provide an additional opportunity for public review in the event that the Trustees decide to make significant changes to the Draft PRP/EA based on the public comments received.

The deadline for submitting written comments on this Draft RP/EA is specified in a notice published by the Trustees in "Primera Hora", a newspaper of general circulation in Puerto Rico, announcing the availability of this document for public review and comment. Written comments on this plan are to be sent by mail, fax or email to:

Sean Griffin,
NOAA Office of Habitat Conservation, Restoration Center
260 Guard Rd, Aguadilla, PR 00603
Email: Sean.Griffin@noaa.gov

1.8 ADMINISTRATIVE RECORD

In accordance with 15 C.F.R. 990.45, the Trustees have established an Administrative Record (AR) of the natural resource damage assessment for this Incident. The AR contains records documenting decisions and information relied upon by the Trustees in the natural resource damage assessment process for the T/V MARGARA Incident, including for the prior emergency restoration actions at the site. It may be used in future administrative or judicial review of Trustee actions to the extent such review is provided by Federal or State law.

The AR is available online at:

http://marineincidents.com/margara_admin_record.html

It is also available for public review at the offices of PRDNER's Marine Resources Division, Dr. Cruz Matos Building, Sector el Cinco, Hwy. 8838, Km. 6.3, Rio Piedras, PR 00926.

Additional information and documents, including public comments received on this and any future draft restoration plans, any final restoration plans, and other restoration planning documents, will be included in the AR as they are developed and completed by the Trustees.

2.0 AFFECTED ENVIRONMENT

This section provides general information on the environment setting in which the Incident occurred and that may be affected by restoration actions considered in this Draft PRP/EA. It includes information on the physical, biological and cultural/human use environments in the vicinity, including those that may be affected by restoration actions proposed in this Draft PRP. The physical environment includes coral reefs off of Guayanilla, Puerto Rico along the southwest coast of Puerto Rico. The biological environment includes a wide variety of tropical marine organisms including corals, fish, shellfish, and other marine invertebrates, including several endangered or threatened species.

2.1 PHYSICAL ENVIRONMENT

The T/V MARGARA site is situated along the outer portion of a carbonate platform south of Bahia de Tallaboa on the south coast of Puerto Rico and are designated as coral reef habitat (NOAA, 2001). Water temperatures in this area range from 24^{o}- 30^{o}C. Depths along the upper shelf in this area range from emergent reefs inshore down to 100' along the shelf edge. Coral reef formations in the area are a combination of patch reefs and spur-and-groove reef formations built by Scleractinian corals over thousands of years. The upper part of these reefs is around 35' deep, and the depth of the channels between the reefs averages 40 - 50' deep. The structure of these formations is composed of a calcium carbonate mantle that is on average 20 cm thick overlaying loose relic *Acropora cervicornis* fossils. The grounding destroyed this mantle in many areas and exposed loose rubble that had been stabilized and sealed in by the crust. The coral reefs affected by the T/V MARGARA Incident within this setting ranged from 30-60' deep and supported an epifaunal assemblage visually dominated by soft and hard corals and sponges (Figure 4).

Figure 4: Photos of un-impacted reef adjacent to the MARGARA site. Photos by NOAA Restoration Center, December, 2008.

The coral reefs along the south coast of Puerto Rico are influenced by trade winds, swells, strong currents, hurricanes and westward-moving terrigenous sediment plumes from run-off. This area is exposed to easterly trade winds that average 15-20 knots and seas that average 6-8 feet at the site. The area is also exposed to hurricanes and associated swells that can reach over 20 feet. High sediment influx, turbid water conditions, and re-suspension of fine grained terrigenous sediments are common. In-water visibility

typically ranges from 30-50 feet but can fluctuate from less than 5 feet after heavy rains and storms to approximately 100 feet on clear days.

2.2 BIOLOGICAL ENVIRONMENT

Coral reefs like those along the south coast of Puerto Rico, including at the T/V MARGARA site, are some of the most biologically diverse ecosystems in the world. Coral reefs provide habitat, spawning and nursery grounds for many marine organisms and fish species, and they are considered hotspots of marine biodiversity (Cesar et al., 2003). The structure of these reefs are built slowly over thousands of years by Scleractinian corals that grow, on average, 0.5 cm per year. The heterogeneous topographic relief afforded by these reefs provides critical habitat for multitudes of fish and marine invertebrates.

Over the last few decades there has been a decline in coral reefs due to bleaching, disease outbreaks (on both corals and other species) and increased algal cover. Many of these conditions have been linked to anthropogenic stressors such as greenhouse gas emissions (which has led to increases in seawater temperatures, ocean acidification and storm frequencies); and increased levels of nutrients, contaminants and sedimentation as a result of dredging, coastal development, pollution, agriculture and other land based sources of pollution (LBSP). Overfishing, increases in LBSP and the Caribbean-wide mass mortality of *Diadema antillarum* in the 1980's has also resulted in increased algal abundances that limit coral recruitment and can smother existing corals. These threats are exacerbated by physical impacts due to ship groundings (like the T/V MARGARA Incident), anchoring and storms; such immediate physical impacts can be dramatic and have long-lasting effects on the reef structure and associated biological communities. The trend of coral reef decline in the Caribbean and the rest of the world over the last few decades makes coral reef resources more valuable, and led to an increasing need and urgency for their restoration and conservation.

Injured resources at the T/V MARGARA site include the Staghorn coral, *Acropora cervicornis*. *A. cervicornis* and *A. palmata* were once the dominant reef building coral species in the Caribbean. Over the last few decades, these species have declinded more than 90% in abundance throughout the region (Bruckner, 2002). In 2006, in the month following the T/V MARGARA grounding, both species were listed as "Threatened" under the Endangered Species Act (ESA). In 2014, five additional coral species from the Caribbean were listed as "Threatened" under ESA. These include *Orbicella faveolata, O. franksii, O. annularis, Dendrogyra cylindrus,* and *Mycetophillia ferox.* All of these species are present at the T/V MARGARA site.

2.3 CULTURAL & HUMAN USE ENVIRONMENT

Coral reefs like those along the south coast of Puerto Rico, including at the T/V MARGARA site, are also among the most economically valuable ecosystems on earth, providing vital ecosystem services to humans. Coral ecosystems are a source of food; protect coastlines from storms and erosion; provide habitat, spawning and nursery grounds for economically important fish species; provide jobs and income to local economies from fishing, recreation, and tourism, are a source of new medicines, and of great cultural importance in many areas (Cesar et al., 2003). Coral reefs are an integral part of Puerto Rico's economy, culture, recreation and tourism. Coral reef ecosystems in Puerto Rico and their associated biological communities generate a multitude of ecological, social, and economic benefits for millions of people throughout Puerto Rico (Burke & Maidens, 2004). Coral reef ecosystem services afforded to Puerto Rico provide shoreline protection, spawning, nursery, and feeding habitat for an array of commercial fishery species and support billions of dollars in tourism revenue (Moberg & Folke, 1999; Harborne et al., 2006; Brander et al., 2007; Estudios Técnicos, Inc., 2007). Fisheries related to coral

ecosystems in Puerto Rico range from artisanal subsistence fishing, commercial fisheries, aquaculture, recreational fishing, the aquarium/marine ornamental trade, and the curio and fashion industries. The fish that grow and live on coral reefs are a significant food source and a very important recreational resource in terms of participation and economic value for people in Puerto Rico (UNEP, 2004).

3.0 ASSESSMENT OF PHYSICAL INJURIES TO RESOURCES

This section summarizes the Trustees' assessment of the physical injuries to the reef and associated resources at the grounding site and of the likelihood of recovery of these resources without further action or intervention. This information provides the basis for and has the informed the Trustees' development of the restoration actions considered and proposed in this Draft PRP/EA.

3.1 DELINEATION OF PHYSICALLY INJURED "SITE"

3.1.1 2006-2007 Mapping

In the period immediately following the Incident, the site was mapped using information provided by an underwater mapping system that involved divers communicating via an underwater wireless communications system and surface buoys with GPS. This effort resulted in the map in Figure 5.

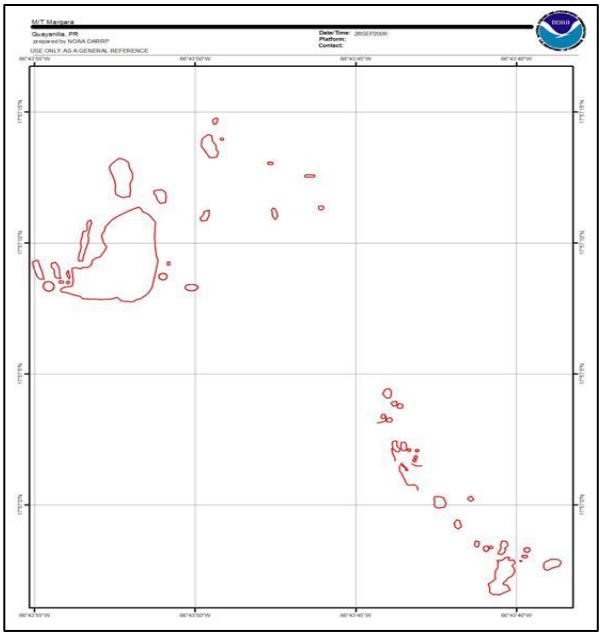

Figure 5: First map of MARGARA impact site from information provided by divers in 2006 using an underwater wireless communications system and surface buoys with GPS.

This first effort provided a rough outline of the "site", i.e. the area affected by the physical grounding, but because of the numerous individual impacts over such a large area, a more comprehensive and systematic approach to mapping of the areas of the site's features was necessary. After considering a number of options, the Trustees elected to undertake an additional site mapping effort using a Multi-beam SONAR[2].

[2] Multi-beam is an active sensor that utilizes acoustic energy to collect measurements of seafloor depth and character. Multi-beam sensors pulse the bottom with a series of soundings normal to the track of the vessel and record the reflected echoes in an orientation parallel to the vessel track. This produces a swath of data that, depending on specific sensor and mission requirements, is normally several times the water depth. Like other acoustic sensors, multi-beam sonar normally collect data in a series of transect lines that allow sufficient overlap to avoid gaps in coverage (NOAA CSC 2011).

This method was the most comprehensive, yet still cost-effective, approach available using current technology. The Trustees arranged for NOAA's Navigation Response Team (already in the area for other work) to conduct the multi-beam effort at the site in November 2006. Trustee and RP divers then used a combination of the original 2006 maps overlaid on the multi-beam charts to develop a consensus set of impact boundaries. These are shown in Figure 6.

After Hurricane Dean passed near the site in 2007, the injury boundaries on the site map were updated based on the post-Dean Trustee/RP diver observations and measurements of the rubble movement and expanded areas of impacts associated with the storm. The updated mapping data was then used in ARCGIS software to determine the total area of impact in square meters (Table 1). The size of the impacted area increased by 633 m^2 after Hurricane Dean due to movement of loose rubble during the storm.

Northern Impact Area **Southern Impact & Propwash Area/**

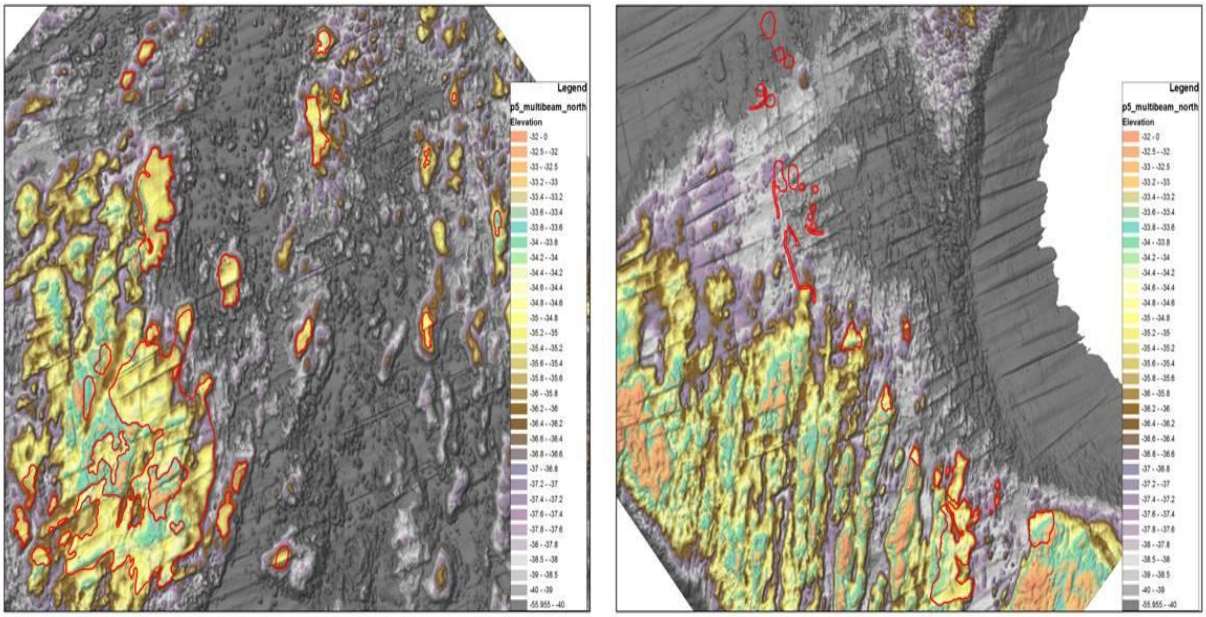

Figure 6: Pre-Hurricane Dean multi-beam images of the T/V MARGARA site with impact areas delineated in red. Northern impact area is on the left; southern impact and propwash areas are on the right.

Location	Pre-Hurricane Dean Size of Impact (m^2)	Post-Hurricane Dean Size of Impact (m^2)
Northern Area	5,530 m^2	6,163 m^2
Central Propwash Area	174 m^2	174 m^2
Southern Area	1,204 m^2	1,204 m^2
Total Impact	6,908 m^2	7,541 m^2

Table 1: Total area of reef impacted by the MARGARA Incident, based on pre- and post-Hurricane Dean measurements. The impacted area increased by 633 m^2 after Hurricane Dean.

3.1.2 Delineation of Habitat Types

To assist in understanding the recovery potential within the different areas of the impact site, the site was further delineated by classifying different levels of impact and/or current bottom type conditions (Figure 7). This was initially done by the Trustees but the delineations were later modified based upon input from the RP's technical representatives. The delineations shown in Figure 7 represent the consensus bottom type classifications post-Dean. Categories include Hard Substrate, Compacted Sediment, Majority Unconsolidated Rubble, and Partially Impacted.

Northern Impact **Southern Impact**

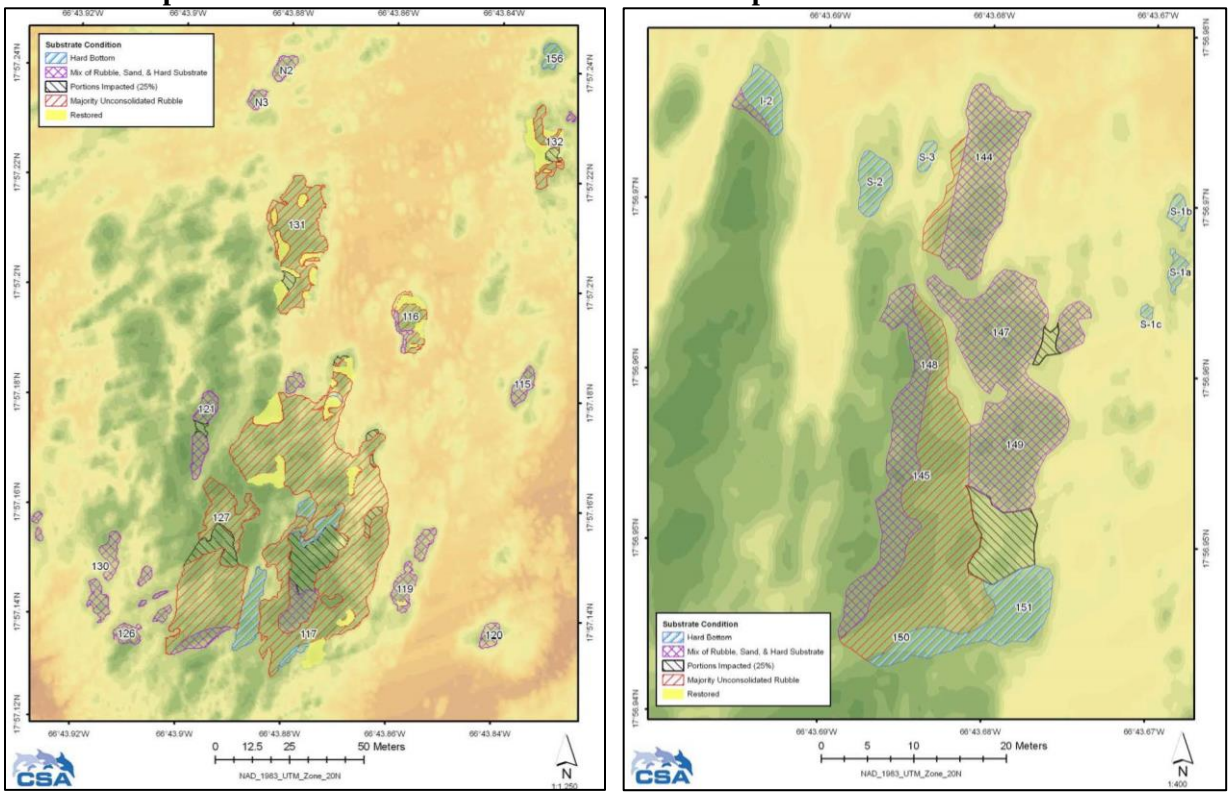

Figure 7: Post-Hurricane Dean T/V MARGARA site maps delineating substrate classifications for the northern impact area (left) and southern impact area (right). Maps produced by Continental Shelf Associates.

In areas classified as "Hard Substrate", the reef structure was still relatively intact post-grounding even though there was a complete loss of coral biota. Recovery of these areas is viewed as likely to occur over time due to the presence of cryptic spaces for recruitment, the lack of sediment which would inhibit settlement of coral recruits, and minimal amounts of rubble available to damage or smother recruits during high energy events.

Areas originally classified as "Compacted Sediment" have been cleared of sediment over the last few years by storms, currents and waves, exposing hard substrate underneath that should also allow for recovery over the long term.

The areas classified as "Majority Unconsolidated Rubble" (Figure 7, however, were of critical concern to the Trustees. From early on, the Trustees expected recruitment and recovery in these areas to be significantly and continuously inhibited by the large amounts of small pieces of rubble in these areas that

had been and would continue to be remobilized during high energy events. This was a substantial point of disagreement between the Trustees and the RP from early on as well, as the RP's technical representatives maintained that site recovery would not be impaired by the large amounts of small rubble present or the lost topographic complexity at the site.

The Trustees conducted surveys at the T/V MARGARA site in 2008 to check the areas that had previously been labeled "Majority Unconsolidated Rubble" and to identify those areas expected to have extended recovery horizons that might warrant additional primary restoration. At the same time, the Trustees began monitoring coral recruitment and survival at the site to provide site-specific data for use to evaluate the recruitment and recovery potential in each area.

3.1.3 2012 Refinements to Delineation of "Majority Unconsolidated Rubble" Areas

An additional joint site visit and mapping effort was cooperatively undertaken by the Trustees' and RP's technical representatives in February 2012 to further refine these areas. Detailed maps were generated using Aquamap (an underwater GPS system). As a result of this effort, the Trustees identified 1,662 m^2 of rubble areas as requiring or warranting additional stabilization as part of a primary restoration plan. Figure 8 depicts the restoration target areas identified by the Trustees in 2008 (beige ovals) and as refined in 2012 (overlaid red polygons). Figure 9 is a subset of the photos that are representative of the areas of the site that would require or warrant further primary restoration action.

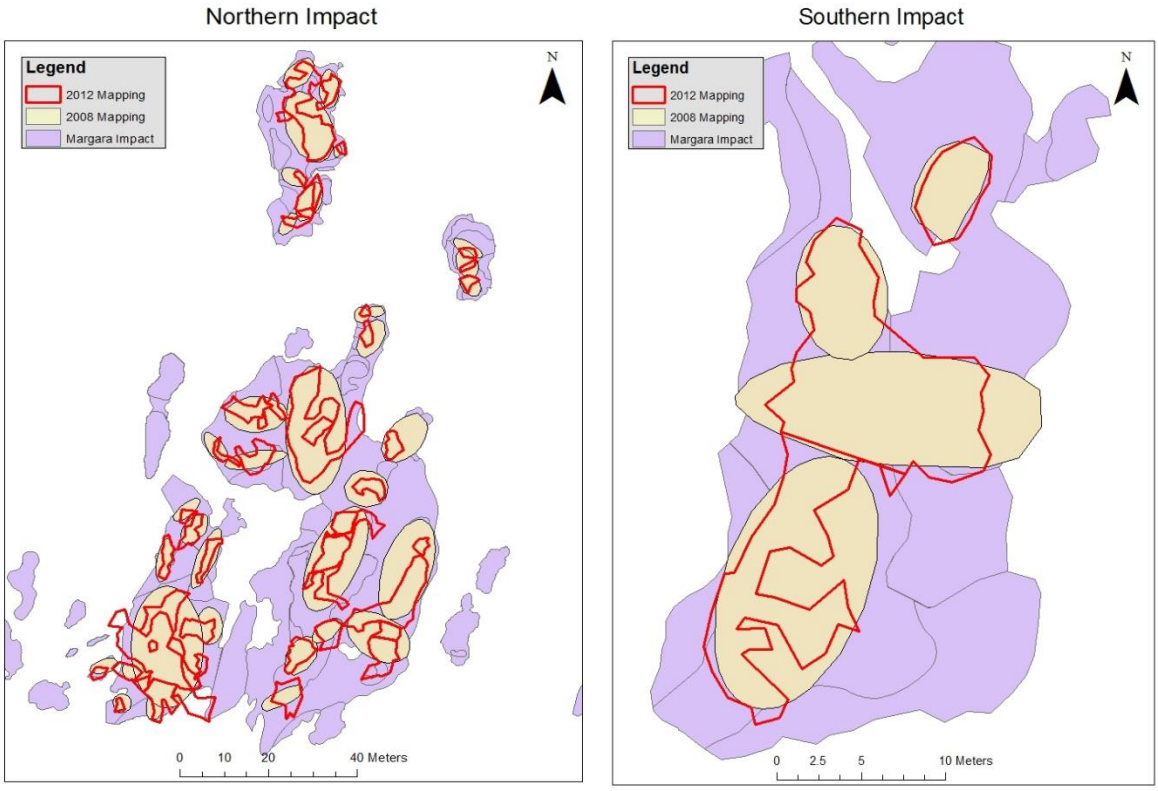

Figure 8: Areas identified for primary restoration by the Trustees in 2008 (beige ovals) and cooperatively by RP and Trustee representatives in 2012 (red polygons) overlaid on map of MARGARA grounding site (purple).

Figure 9: Photos of rubble and some of the areas needing primary restoration at the MARGARA site. Photos by NOAA Restoration Center, December 2008.

3.2 LOST TOPOGRAPHIC COMPLEXITY

Prior to the T/V MARGARA grounding, the impacted reef site was topographically complex, with high and low relief areas, and a combination of patch reefs and spur-and-groove reef formations. After the grounding, the tops of the patch reefs and spurs were flattened to a very uniform level with very little or no topographic complexity within individual impact areas. Measurements taken during bi-annual fish and benthic monitoring events at the site since 2012 have shown that the average difference between the highest and lowest areas in the rubble fields is approximately 10 cm compared to an average of 50 cm in unimpacted areas. Measurements ranged from 3 - 25 cm in rubble areas compared to 15 – 100 cm in reference areas. These measurements show how the impacted areas have been completely flattened compared to the heterogeneous complex reef system that it once was and is still present in the adjacent unimpacted areas. It is a reef's heterogeneous topographic relief that provides critical habitat for fish and marine invertebrates. Damaged high relief areas may never recover to their previous status or it may take prohibitively long to regrow without proactive restoration to recreate the habitat (Precht el al., 2001; NOAA, 2002; Rinkevich, 2005).

3.3 DIRECT BIOLOGICAL LOSS

To determine the extent of the coral biota loss at the T/V MARGARA site, 10 m^2 belt transects were performed in un-impacted reef areas adjacent to the site (Figures 10 and 11). A total of 32 transects covering 320 m^2 were conducted during two field events (October 2006 and May 2008). Data recorded in the belt transects included the coral species present and their respective size class (10 cm increments). This data was used to estimate coral densities, species diversity and size distributions by species

classification in each of the three distinct areas that were impacted: the Northern Impact area, the Southern Impact area and the central area damaged by prop wash that was a little deeper and just to the north of the Southern Impact area (Table 2). Coral densities in the Northern impact area were 8.5 scleractinians per m^2 and 16.2 octocorals per m^2. Scleractinian densities in the southern area averaged 6.6/m^2 and octocorals averaged 19.5/m^2. In the central prop wash area, average densities were 3.5 scleractinians/m^2 and 12.6 octocorals/m^2. The average density of corals per m^2 and the total area of impact were then used to calculate the total number of corals impacted by the MARGARA Incident, by species class (Table 3). Using this data and approach, the Trustees calculated that 61,022 scleractinian corals and 125,374 octocorals were impacted as a result of the T/V MARGARA grounding, for a total of 186,396 corals.

Northern Impact **Southern Impact & Propwash Area**

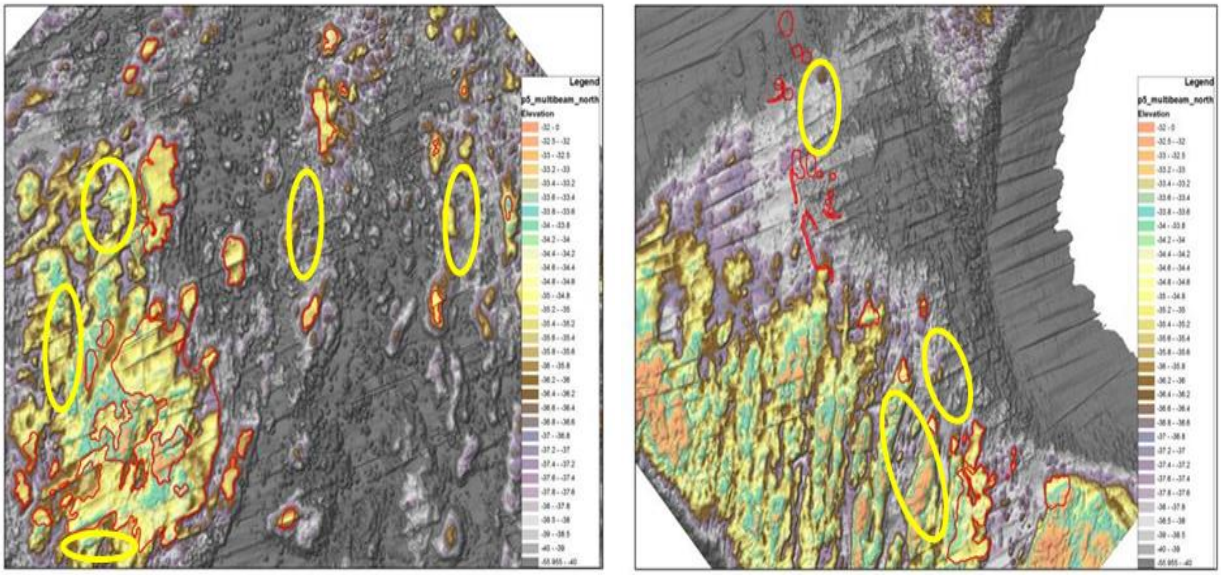

Figure 10: Location of reference transects (yellow polygons) adjacent to MARGARA site (impacted areas delineated in red).

Figure 11: Photos of un-impacted reef adjacent to the MARGARA site where reference transects were conducted. Photos by NOAA Restoration Center, December 2008.

Transect Location	Density of Scleractinians/m^2	Density of Octocorals/m^2
Northern Area	8.5 ± 1.9	16.2 ± 4.3
Central Propwash Area	3.5 ± 2.5	12.6 ± 5.0
Southern Area	6.6 ± 2.7	19.5 ± 4.6

Table 2: Density of Scleractinians and Octocorals in the three different areas at the T/V MARGARA site.

Location	Size of Impact (m^2)	Scleractinians Impacted	Octocorals Impacted	Total Corals Impacted
Northern Area	6,163 m^2	52,444	99,753	152,197
Central Propwash Area	174 m^2	616	2,189	2,805
Southern Area	1,204 m^2	7,961	23,433	31,394
Total Impact	7,541 m^2	61,022	125,374	186,396

Table 3: Total number of corals assessed as lost as a result of the T/V MARGARA Incident.

3.4 SITE RECOVERY MONITORING & OUTLOOK

The coral recruitment and survival monitoring that the Trustees initiated in 2008 included monitoring in unconsolidated rubble fields, in consolidated hard substrate areas, on restoration structures, in the surrounding un-impacted reef and at the nearby T/V SPERCHIOS grounding site, a site with little to no loose rubble and where the impacted site was and remained consolidated hard substrate[3]. Permanent $10m^2$ belt transects and 25cm x 25cm quadrats were set up in each area. Belt transects allowed for data to be collected on coral densities, species diversity and size distribution and how they changed over time in each area. The permanent quadrats allowed data to be collected on recruitment survival rates over time. A total of 45 recruitment quadrats and 9 permanent belt transects were set up in the rubble fields and on the restoration structures at the T/V MARGARA site and 30 recruitment quadrats and 6 permanent belt transects were set up in the impacted area at the T/V SPERCHIOS grounding site and in the reference area adjacent to the T/V MARGARA site. Data was collected annually from 2008-2012.

The recruitment monitoring data at the T/V MARGARA site from 2008 through 2012 shows that coral recruit survival in the rubble fields is on average between 0-18% compared to survival rates of 58-65% in the reference area and 49-56% in the restored areas. Scleractinian (stony coral) recruitment survival rates were 0% in rubble compared to 83-100% in the reference area and 40-42% in the restored areas. Octocoral recruitment survival was 8-18% in rubble, 58-65% in the reference area and 49-56% in the restored areas. Figures 12 and 13 show the change over time in mean number of corals in the monitoring quads and belt transects at the T/V MARGARA site (injury, restored area and reference) as well as at the nearby T/V SPERCHIOS grounding site (which does not have rubble present like at the T/V MARGARA site). The graphs in Figures 12 and 13 show how the T/V SPERCHIOS site is recovering with time while the T/V MARGARA rubble fields have limited to no recovery seven years after the Incident. In the belt transects, recovered octocoral densities are an order of magnitude greater at T/V SPERCHIOS than at the T/V MARGARA site, and recovered Scleractinian densities are two orders of magnitude greater at the T/V SPERCHIOS than at the T/V MARGARA site. There are almost no Scleractinians present in the rubble at the T/V MARGARA site, and densities of coral recruits at the site are below the 2008 Post-Hurricane Dean levels. The data shows that recovery in the rubble fields at the T/V MARGARA site is not occurring.

[3] The T/V MARGARA and the T/V SPERCHIOS groundings also occurred within six months of each other.

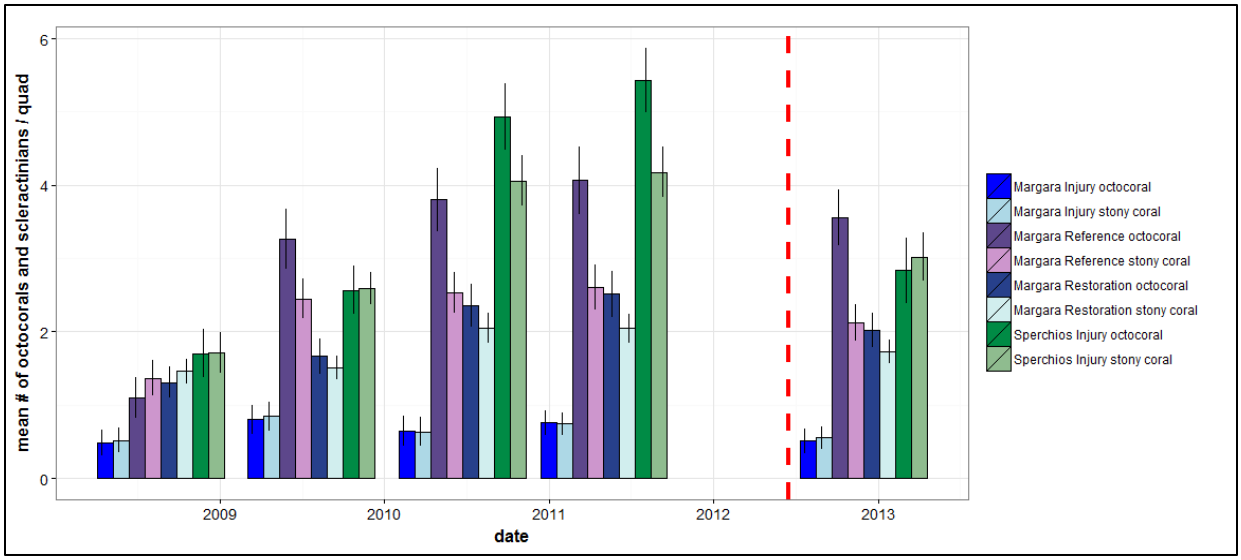

Figure 12: Mean number of scleractinians and octocorals per recruitment quad at the T/V MARGARA site, the T/V SPERCHIOS grounding site, restored areas and reference areas. Initial recruitment quadrats (25 cm x 25 cm) were established in August, 2008 (year following Hurricane Dean). The red dotted line represents Tropical Storms Ernesto and Isaac where swells reached 20' in August, 2012. Error bars represent standard error of the mean.

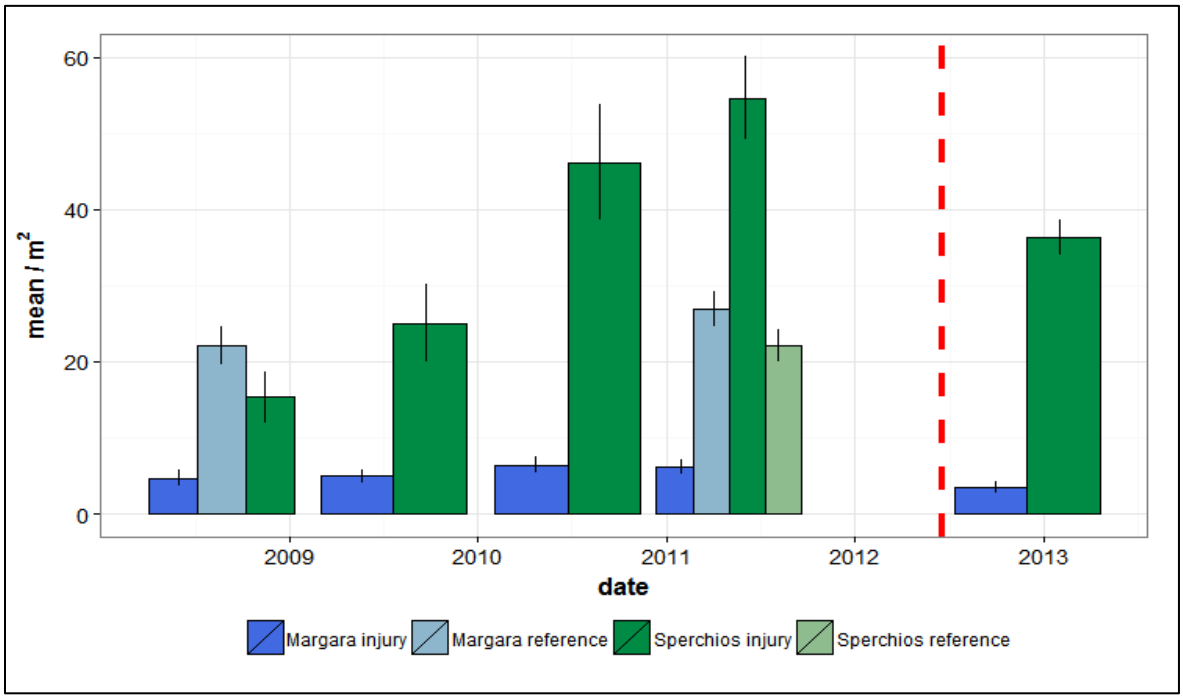

Figure 13: Mean number of corals in belt transects at the T/V MARGARA site, the T/V SPERCHIOS site and in reference areas. Permanent belt transects (1m x 10m) were established in August, 2008 (year following Hurricane Dean). The red dotted line represents Tropical Storms Ernesto and Isaac where swells reached 20' in August, 2012. Error bars represent standard error of the mean.

This evidence is consistent with results reported from other scientific studies. Fox (2003) established that low survival rates in rubble fields were due to post-settlement mortality and not recruitment limitations. Moderate or high recruitment on rubble fields is therefore not an accurate measurement of recovery success (Fox, 2003). Raymundo (2007) reported a mean survival rate of 6% of recruits in rubble fields compared to a 63.4% survival rate in reference areas during an assessment of a rubble field created by blast fishing events. Further analysis revealed that recruits in reference areas displayed significant growth compared to recruits settled onto unconsolidated rubble, which displayed signs of abrasion or partial mortality. It is highly unlikely that corals recruiting onto loose rubble will demonstrate significant growth. Consequently, coral cover and abundance are not expected to increase due to these limitations, and the biological function of the affected reef system will not be restored (Raymundo, 2007).

Fox (2003) also reported that the highest recruitment in rubble fields occurred in areas with low currents and low frequency of severe storm action, while low recruitment rates were observed in areas with high current action and where storms were common. Unconsolidated rubble can be detrimental to small coral recruits and other biota as it is highly dynamic and will move as a result of wave actions or currents. In addition, unstable, crushed rubble can increase the amount of suspended particles in the water column (Fox, 2003). Increased turbidity may retard recovery and reduce post recruitment survival of coral recruits along with having harmful effects on the otherwise healthy biota in adjacent un-impacted reef (Jaap, 2000).

Rubble stabilization through natural processes occurs through preliminary stabilization by sponges, algae, etc. followed with rigid binding from corals and diagenetic cementation. The prerequisite for the start of preliminary stabilization by sponges, algae, etc. is the decline and/or protection from hydrodynamic energy (storms and waves). "Coralline algae rigidly bind rubble only in very shallow fore-reef environments. Rubble binding does not appear to be easily achieved and fewer reports of bound rubble were found than of loose rubble" (Rasser and Riegl, 2002). Predicted timelines for recovery of rubble fields can be seen in Table 4. One example of a very old grounding site with persistent rubble issues is "the oldest investigated, and still uncemented, rubble from the grounding of the 'Carnatic' on windward Shaab Abu Nuhas in 1869" in the Red Sea (Riegl and Luke, 1998).

Time	Location	Source
40 [(1)] – 150 years	Worldwide (Depths < 5 meters)	Rasser and Riegl, 2002
40 – 70 years	Hawaii	Dollar and Tribble, 1993
40 years to 50% recovery	Philippines	Alcala and Gomez, 1979
50 years [(3)]	Grand Cayman	Blanchon et al., 1997
100 years	Virgin Islands	Aronson et al., 1994 [(2)]
100 – 150 years	Bermuda	Cook et al., 1994 [(2)]
100 years to possibly never	Spur and Groove Habitats	Precht et al., 2001
A few hundred years [(4)]	Enewak Atoll	Buddemeier et al., 1975
Several hundred years	Red Sea	Riegl and Luke, 1998
Very slow to nonexistent	Indonesia	Fox et al., 2003

(1) Rasser and Riegl cites this period as 5 – 150 years including two references that do not apply as they refer to *A. cervicornis* regrowth after hurricanes (Shin, 1976) and coral growth at sections of the Wellwood grounding with little or no structural impact (Gittings et al., 1994).
(2) Cited in Rasser and Riegl, 2002
(3) Recovery of shallow *A. palmata* dominated reefs
(4) 10 – 15 cm thick mantle

Table 4: Predicted timelines for recovery of rubble fields to previous conditions

Corals are capable of settling and recruiting onto unconsolidated pieces of rubble and monitoring conducted at the T/V MARGARA rubble fields did reveal numerous coral recruits, a majority of which were soft corals. Their growth and survival, however, is significantly reduced as the loose rubble they are attached to become mobile and are buried or overturned thereby smothering and consequently killing coral recruits.

Limited recruitment by large reef-building species like *Orbicella* spp. and *Diploria* spp. can delay or even preclude the complete recovery of the original coral community (Gittings et al., 1990). Growth rates for the majority of Caribbean coral species are also considerably low, averaging 0.5 cm/yr for most species (Highsmith et al., 1983; Hubbard and Scaturo, 1985).

Because of the slow recovery rate for many Caribbean coral species, the T/V MARGARA site will also need active biological restoration to jump start the recovery process in addition to physical restoration of the site. Candidates for transplantation include dislodged colonies from surrounding sites; corals that are growing on nearby man-made structures that are deteriorating; corals that were reattached to rebar supported modules during the emergency restoration activities and which are now in jeopardy of becoming unstable due to site erosion; and nursery reared (*A. cervicornis*) colonies that are of sufficient size and health to be viable.

Without active restoration, the prospects for recovery of the reef's lost topographic complexity are similar. High relief areas will not recover to their original community structure without a proactive restoration program to encourage reef development (NOAA, 2002; Rinkevich, 2005). Damaged spur-and-groove habitat will not recover rapidly to its former state and may not recover at all without substantial restorative engineering (Precht el al., 2001). When the reef structure and substrate is broken down into rubble and sand, the reef's ability to recover from natural processes of recruitment is diminished. Loose, broken substrate is dynamic and can be easily moved by storms and current. Settled corals may endure higher sedimentation and increased mortality from overturning and abrasion. This type of habitat is favorable for soft coral aggregations that compete with new hard coral settlers (Fox et al. 2003). The loss of topographic complexity has serious implications for reef recovery and fish and sea urchin populations in spur-and-groove habitats. Restoration efforts must include re-establishment of the topographic complexity to enhance recruitment and growth of coral species that naturally occur in spur-and-groove habitats (Aronson and Swanson, 1997).

The Trustees consider the recovery potential of the coral reef community at the T/V MARGARA site to be critically dependent upon rubble stabilization and restoration of topographic relief.

4.0 PRIMARY RESTORATION PLAN - ALTERNATIVES CONSIDERED & PROPOSED ACTIONS

4.1 OVERVIEW OF RESTORATION PLANNING PROCESS

The goal of restoration planning under OPA is to make the environment and the public whole through the identification and implementation of restoration actions that are appropriate to restore, rehabilitate, replace or acquire natural resources or services equivalent to those injured or lost due to unlawful discharges of oil or actions taken in response to the substantial threat of such discharges. The NRDA OPA regulations direct that this goal be achieved by returning injured natural resources to their baseline condition, but for the incident, and by compensating for any interim losses of natural resources and services during the period of recovery to baseline. Thus, as noted previously, restoration planning may involve two components: primary restoration and compensatory restoration. This Draft PRP/EA is concerned with primary restoration, those actions that are required or appropriate to assist or accelerate the return of resources and services at the T/V MARGARA site to their pre-injury or baseline levels.

The Trustees have approached restoration planning with the view that the injured natural resources are part of an integrated coral reef ecosystem and that the coastal waters off the south coast of Puerto Rico represent the relevant geographical area for siting restoration actions. The Trustees also recognize restoration actions should be consistent with local community objectives. Alternatives were considered more favorably if complementary with other community development plans/goals, local planning strategies, resource agencies priority setting documents, and species recovery plans.

In developing this Draft PRP/EA, the Trustees have considered the need for and a range of alternatives appropriate to meet the goals of primary restoration under OPA. The Trustees have considered options for active primary restoration at the site as well as the natural recovery alternative. For the T/V MARGARA site, the Trustees' decision whether or not to proceed with active primary restoration or natural recovery will have an appreciable effect on the scope and scale of compensatory restoration required to offset interim losses of natural resources and services. The Trustees' evaluation of alternatives and their proposed primary restoration plan is presented beginning with Section 4.4.

4.2 OBJECTIVES OF PRIMARY RESTORATION PLANNING FOR THE T/V MARGARA SITE

The goal of primary restoration for the T/V MARGARA site is to assist and accelerate recovery of the structural and biological components of the injured reef. Though it is not possible to actively restore the thousands of years of coral growth that comprised the physical structure of the reef pre-impact or all the living coral organisms that were lost, actions with the potential to increase recruitment success and survival, return topographic complexity to the site, promote growth of coral biota and ultimately reduce the recovery time of the site have been identified and considered, as has the "No Action" alternative. The Trustees' preferred alternative (a set of actions) is proposed in this plan.

4.3 CRITERIA FOR IDENTIFICATION & EVALUATION OF ALTERNATIVES

In identifying and evaluating primary restoration alternatives, the NRDA regulations at 15 CFR Part 990.53, provide that Trustees may consider actions that:

(i) Remove conditions that would prevent or limit the effectiveness of any restoration action;
(ii) May be necessary to return the physical, chemical, and/or biological conditions necessary to allow recovery or restoration of the injured natural resources; or
(iii) Return key natural resources and services, and would be an effective approach to achieving or accelerating a return to baseline

For primary restoration alternatives identified under 15 CFR 990.53, the Trustees are also to consider (15 CFR 990.54):

(1) The cost to carry out the alternative;
(2) The extent to which each alternative is expected to meet the trustees' goals and objectives in returning the injured natural resources and services to baseline and/or compensating for interim losses;
(3) The likelihood of success of each alternative;
(4) The extent to which each alternative will prevent future injury as a result of the incident, and avoid collateral injury as a result of implementing the alternative;
(5) The extent to which each alternative benefits more than one natural resource and/or service; and
(6) The effect of each alternative on public health and safety

Additionally, the NRDA regulations require that all actions considered be technically feasible and capable of being implemented in accordance with applicable laws, regulations, and permits.

When considering primary restoration, OPA requires the Trustees evaluate both a natural recovery alternative and one or more active primary restoration alternatives. The natural recovery alternative assumes that no human intervention would be taken to directly restore injured natural resources and services to baseline. This is, in this context, equivalent to the "No Action" alternative under NEPA. An active primary restoration alternative is one comprised of actions that could be taken to directly restore the injured natural resources and services to baseline and/or to accelerate recovery of those resources or services.

4.4 IDENTIFIED ALTERNATIVES FOR PRIMARY RESTORATION

Throughout the emergency restoration and restoration planning process for this Incident, the Trustees gathered information on potential primary restoration alternatives from regional resource managers and regulators; coral restoration literature and practitioners; regional non-governmental organizations; informed members of the public; and the RP. Ideas regarding potential components of active restoration at the site are varied, and involve a variety of methods and materials, but each can be grouped as a means of addressing one or more of the following restoration strategies:

- Stabilizing loose rubble to increase recruitment survival;
- Restoring topographic complexity created by the non-live-coral substratum in a way that mimics reference areas;
- Providing for biological enhancements at the site.

The primary restoration alternatives that were identified and considered were: 1) capping rubble with cement; 2) rubble removal; 3) creation and placement of limestone modules; 4) biological enhancement;

5) a combination of limestone modules along with biological enhancement; and 6) no action (natural recovery alone). While many of these and other approaches are promoted by researchers, entrepreneurs, and others as viable methods for promoting and accelerating the recovery of reef resources, and some have been used successfully, the opportunity for success often depends on the specific biological and environmental conditions at the site needing to be restored. In considering these alternatives, therefore, the Trustees considered each of them in the context of their constructability and/or likelihood of success under the conditions at and relevant to recovery of the injured reef resources at the T/V MARGARA site. The Trustees also considered the extent to which each alternative could contribute to a comprehensive, cost-effective plan with the highest likelihood of success at meeting the primary restoration objectives.

4.5 EVALUATION OF ALTERNATIVES

This section lists the primary restoration alternatives considered by the Trustees and summarizes the results of the Trustees' evaluation of those alternatives in light of the objectives for restoration of both the structural and biological components of the reef injured by the T/V MARGARA Incident.

The alternatives that were identified and considered are: 1) capping rubble with cement; 2) rubble removal; 3) creation and placement of limestone modules; 4) biological enhancement; 5) a combination of limestone modules along with biological enhancement; and 6) no action (natural recovery alone). The Trustees considered each of these relative to its ability to meet the restoration goals to be achieved for successful restoration of injured reef resources at the T/V MARGARA site to occur. These goals are: rubble stabilization, return of topographic complexity, increased coral recruitment success, and enhancing or accelerating recovery of reef biota. Each primary restoration alternative was assessed on a scale of 0 to 3 based on the likelihood of success to achieve each of these goals (with 0 being low chance of success; 3 having a high likelihood of achieving that goal). Table 5 shows the Trustees' assessment of each Primary Restoration Alternative by primary restoration goal for the T/V MARGARA site.

	Primary Restoration Goals:				
Restoration Alternatives:	**Rubble Stabilization**	**Return of Topographic Complexity**	**Increase Coral Recruitment Success**	**Enhance or Accelerate Biological Recovery**	**Total Score**
Capping Rubble with Cement	3	0	2	0	5
Rubble removal	2	0	2	0	4
Creation/Placement of Limestone Modules	3	3	3	0	9
Biological Enhancement	1	0	1	3	5
Limestone Modules with Biological Enhancement	3	3	3	3	12
No Action (natural recovery only)	0	0	0	0	0

Table 5: Primary Restoration Alternatives – Trustees' Ratings of Likelihood of Meeting Primary Restoration Goals for T/V MARGARA Site. Rating scale: 0-3 (0=zero likelihood of success; 1=very limited or small scale success expected; 2=good likelihood of success but with some caveats/limitations; 3=high chance for success).

While Table 5 evaluates the extent to which each alternative is expected to meet the trustees' primary restoration goals and objectives and the likelihood of success of each alternative, it does not explicitly evaluate the alternatives against the additional criteria listed in Section 4.3 and 15 CFR 990.54: (1) The cost to carry out the alternative; (2) The extent to which each alternative will prevent future injury as a result of the incident, and avoid collateral injury as a result of implementing the alternative; (3) The extent to which each alternative benefits more than one natural resource and/or service; and (4) The effect of each alternative on public health and safety. Table 6 below provides an overview of the Trustees evaluation of these factors that was used to inform the selection of the Preferred Primary Restoration Alternative.

Restoration Alternatives:	**Cost of the Alternative**	**Prevention of Future Injury**	**Multiple Resource Benefits**	**Effect on Public Health & Safety**	**Total**
	1 = High Cost 2 = Moderate Cost 3 = Low Cost	*1 = Low Prevention 2 = Moderate Prevention 3 =High Prevention*	*1 = Low Likelihood of MB 2 = Moderate Likelihood of MB 3 = High Likelihood of MB*	*1 = Negative effect on PH&S 2 = Neutral effect on PH&S 3 = Positive effect on PH&S*	
Capping Rubble with Cement	2	3	1	2	8
Rubble Removal	1	2	1	2	7
Creation/Placement of Limestone Modules	2	3	2	2	9
Biological Enhancement	3	1	1	2	7
Limestone Modules with Biological Enhancement	2	3	3	2	10
No Action (natural recovery only)	3	1	1	2	7

Table 6: Primary Restoration Alternatives – Trustees' evaluation of additional evaluation criteria.

Utilizing the evaluation criteria presented in Section 4.3 and reviewed in Tables 5 and 6, Limestone Modules with Biological Enhancement emerged as the most viable and likely to be successful primary restoration alternative based on T/V MARGARA site conditions. This mix of techniques represented the best approach to meeting the primary restoration objectives for the site. Accordingly, the Trustees are proposing the Limestone Modules with Biological Enhancement approach as the preferred alternative to address the primary restoration needs of the injured reef resources at the T/V MARGARA site. Section 4.6 describes the proposed actions and provides additional information regarding the Trustees' evaluation of this alternative. Consistent with the role of this document as a draft EA under NEPA, Section 5.0 presents the information relating to and the Trustees' evaluation of potential effects of these proposed restoration actions in this setting.

Each of the other primary restoration alternatives is described further below, together with a summary of the Trustees' evaluation of each alternative's ability to meet the primary restoration objectives for the injured reef resources at the T/V MARGARA site.

- ***Capping Rubble with Cement***

This option involves pouring cement over the rubble areas to prevent future mobilization. While this alternative would stabilize the rubble, it would not return topographic complexity to the site and does not offer biological enhancement. Coral topography may never recover on its own in a situation like at the T/V MARGARA site without primary restoration (Precht et al., 2001; NOAA, 2002, Rinkevich, 2005). The stabilized rubble areas would enhance coral recruitment but coral recruitment would not be as successful as on a three dimensional structure with lots of crevices and pores. Areas that have more topographic complexity also have higher coral recruitment rates and success than flat hardbottom areas (Maida et al., 1994) similar to one that would be created under this scenario.

- ***Rubble Removal***

This method involves removing the rubble at the site down to hard substrate. While this method would provide some direct stabilization in some areas, there is risk that this may expose some reef areas to scouring, causing additional erosion of reef areas and injuries at the site, and potential future burial of the recently exposed substrate in lower areas. In some places, the rubble goes down 10'+. It is unclear how deep the actual hard substrate may be in most areas and it is difficult to estimate how much rubble will have to be removed. Recruitment success would be expected to improve in areas where hard substrate is exposed and would remain so. This alternative does not return topographic complexity to the site, nor is there any biological enhancement to jumpstart recovery at the site.

- ***Creation and Placement of Limestone Modules***

This alternative involves creating and placing limestone modules and/or a series of medium and large boulders on top of the rubble. This alternative would stabilize the rubble, return topographic complexity to the site and increase coral recruitment success at the site by providing available substrate on a three dimensional structure with lots of cracks and crevices that favor coral recruits (Maida et al., 1994). This alternative alone does not provide any biological enhancement to jump start recovery at the site.

- ***Biological Enhancement***

This alternative involves transplanting corals from at risk sites and coral nurseries along with cropping from donor colonies of octocorals and sponges. This alternative would meet the goal of biological enhancement to jump start recovery at the site but would not return topographic complexity to the site. There would be very limited localized effects on recruitment and rubble stabilization, particularly right where the corals are reattached, but that won't address the majority of the rubble areas. There is a high risk that without more extensive rubble stabilization efforts, these transplants will fail as results of rubble mobilization during storms and high waves events.

- ***No Action (Natural Recovery alone)***

The No Action Alternative would allow natural recovery to take place on its own. As explained in Section 3.4, monitoring at the site since 2008 shows recovery is not occurring. Repeated rubble movement at the site from weather and waves is preventing recruits from surviving. Under the No Action Alternative, rubble stabilization would not occur, additional biological injuries and losses may occur due to remobilization of rubble during storms, the site's topographic complexity would not occur

in a meaningful timeframe, biological recruitment will continue to be frustrated, and reef recovery at the site would be delayed and/or may never occur. Section 4.9 presents additional information relating to the Trustees' evaluation of the No Action Alternative in this setting, including for purposes of the EA included in this document.

4.6 PROPOSED PRIMARY RESTORATION: LIMESTONE MODULES WITH BIOLOGICAL ENHANCEMENT (PREFERRED ALTERNATIVE)

4.6.1 Project Description

The proposed primary restoration actions have two active components, to be accomplished in two phases. The first component is the creation and placement of limestone modules to provide both structural enhancement of the site to restore topographic complexity and to stabilize the substrate in the unstable rubble areas. The second component is biological enhancement of the site through the active transplantation of corals on hard substrates and restoration structures. In combination, these activities would address all of the following primary restoration needs:

- Stabilize loose rubble to increase recruitment survival and allow recovery to begin;

- Restore topographic complexity created by the non-live-coral substratum in such a way that it mimics reference areas.

- Provide for enough biological enhancements to allow the natural recovery process to be jumpstarted or accelerated.

In Phase 1, individual module structures (or patch reefs) would be constructed and placed within unstable rubble areas designated for primary restoration by the Trustees in Figure 8 to cover and stabilize as much these areas as possible while also leaving grooves between the areas to maximize the restored footprint and mimic the surrounding spur and groove reef profile. Each patch reef would be constructed utilizing quarried limestone boulders and a firmly secured bonding agent, such as cement, to stabilize the boulders within the habitat. One or more of these structures will be placed to cover and stabilize up to 70% of each area designated for primary restoration. The structures will be required to meet the following minimum construction criteria:

i) Constructed using clean, quarried (source approved by Trustees), karsted-quality, pressure washed limestone boulders and loose material available from the site, tied together and appropriately anchored (e.g., with 3/8" steel or 5/8" fiberglass rebar) and securely bonded with a mix of Portland Cement and Silica Sand.
ii) A combination of medium (100 - 1,000 lbs[4]) to large (approximately 1 - 2 ton[5]) boulders will be deployed to create restoration structures of varying sizes and weights to recreate topographic relief. The final ratio of medium to large boulders is subject to approval by the Trustees.
iii) Constructed restoration structures will need to be anchored to existing hard substrate at the site. In areas where the thickness of the rubble layer precludes anchoring the structures to solid substrate, restoration structures will be constructed with the goal of achieving a minimum of 4 tons in weight to ensure each structure is of sufficient size and weight to avoid shifting or movement during a storm event producing the maximum expected wave height,

[4] The Trustees anticipate a relatively even size distribution within this weight range, with an average boulder weight of ~ 500 lbs.
[5] The Trustees anticipate using 20 to 60 boulders in this weight range.

which is calculated to be approximately 30 feet by the design wave determination and stability analyses performed by Coastal Planning and Engineering Inc.[6]. To meet this goal, at least 3 cubic yards of limestone will be incorporated into unanchored structures.

iv) Structures will be configured based on the contours of each restoration target area but will have a minimum width of 1m.

v) Structures will be configured so the vertical relief of each will vary and range from approximately 0.3 to 1 m, with all unanchored structures having at least one point in excess of 1 m and no structures elevated more than 2 m.

Within the individual areas selected for application of constructed patch reefs, placements will be spaced and oriented to provide maximum protection of the area from storm events as well as to secure the existing reef to prevent undermining. By placing the constructed patch reefs adjacent to and incorporating them into existing reef, the supplemental concrete and limestone will aid in the prevention of further scouring of the intact reef. The general method proposed is a variation of the same techniques used successfully for the restoration of the nearby T/V MATTHEW grounding site in Guayanilla, Puerto Rico; the T/V PORT STEWART grounding site in Yabucoa, Puerto Rico; the COLUMBUS ISELIN grounding site at Looe Key, Florida; and the ALLIE B and IGLOO MOON grounding sites in Biscayne National Park, Florida.

In Phase 2, biological enhancement on hard substrates and restoration structures will be accomplished by transplanting *A. cervicornis* corals from the on-site coral nursery established in 2006 after the T/V MARGARA Incident (expected to be ~ 1,200 colonies), other coral species from other at-risk sites in the area and, to maintain species diversity, small clippings of octocorals and sponges from the surrounding reef. The donor sites will include derelict vessels (the PRINCESS and the PAWNEE) as well as the deteriorating dolphin structures at an abandoned defunct oil transfer facility in Guayanilla. The corals growing on these structures (expected to be ~ 350 colonies) will be transferred and attached to the limestone reef modules using cement or epoxy.

Upon completion of these actions, monitoring of the restoration will be conducted at scheduled intervals to evaluate the structural stability of the restoration features, survival and stability of the reattached corals and recruitment/colonization trends to determine that recovery is underway. To gauge recovery, the Trustees propose to monitor recovery at the site for 10 years. Coupled with data collected during prior years, this will provide over 15 years of data since the Incident. If recovery does not progress as anticipated, identifiable issues may be evaluated and addressed through adaptive management or corrective actions at the site (including additional primary restoration activities). The need for major corrective action may be required if destabilization or substantial loss of reattached structural enhancement material (approximately 10% or more) occurs or if dislodged and/or failing structures are likely to cause ancillary damage to the restored area or to adjacent reef.

The proposed primary restoration actions are expected to restore topographic complexity to the site, possibly to a level sufficient to resolve interim lost topographic services, and to reduce the recovery horizon of the T/V MARGARA site to the time it will take re-colonized coral recruits and transplanted corals to reach size distributions similar to that in the surrounding reef The exact difference between natural recovery versus the proposed active primary restoration in terms of reducing the interim coral losses cannot be determined because, without rubble stabilization, recovery at the site is not likely to occur and the extent of damage at the site could potentially increase.

[6] This report is entitled "Margara Reef Repair Project, Project Site Wave Data and Reef Repair Stability Analysis" and is included in the AR.

4.6.2 Performance Criteria and Monitoring

Performance criteria define short-term milestones that, if met, will provide reasonable assurance of project success in the long term. Monitoring provides information necessary to determine whether the project is trending toward these milestones or whether corrective action may be appropriate.

Performance criteria for the proposed Primary Restoration actions are:

i) Topographic complexity created by the non-live-coral substratum is returned to within 10% of agreed reference areas using the calculation for topographic complexity that is $C=1-d/l$[7]

ii) Structures are expected to remain stable and intact. Corrective action will be necessary if approximately 10% or more of the structures become loose; 10% or more of the reattached limestone is lost; or if dislodged and/or failing structures are likely to cause ancillary damage to the restored area or to adjacent reef.

Restoration monitoring will be conducted at scheduled intervals following construction. Annual monitoring events will monitor the structural stability of the restoration features, survival and stability of the reattached corals and recruitment/colonization trends to determine that recovery is underway. The post-restoration monitoring plan will be initiated within 90 days after construction is completed. After this, data will be collected annually for 5 years and then again at years 7 and 10. A temperature logger will be deployed at the site during the initial monitoring and changed out during each of the subsequent monitoring events. If there is a disease outbreak or high mortality in the transplanted corals, the logger may provide important information to help determine the cause of the event. Other visits may be required periodically to inspect the restoration site for potential damage due to effects of storms or other events. The objectives and methods to be used in monitoring are shown below in Table 7.

No routine maintenance of the stability of the restoration structures is expected. However, during the first 12 months, minor corrective actions may be needed to support the biological reestablishment. The Trustees would conduct any minor corrective actions they believe are necessary to assist or enhance the growth and development of the reef biota. Examples of minor corrective actions include the following:

i) Securing loose coral fragments that have broken or otherwise become detached.

ii) Removal of small amounts of debris and other obstructions from the site and/or surrounding areas.

iii) Removal of unacceptable and/or invasive species

At the time of completion, major corrective action may be required if the project does not meet the construction criteria set forth in Section 4.6.1. The need for major corrective action may also be triggered if destabilization or substantial loss (approximately 10% or more) of reattached structural enhancement material or corals occurs or if dislodged and/or failing structures are likely to cause ancillary damage to the restored area or to adjacent reef.

[7] Topographic complexity will be measured using the chain method and the calculation C=1 - d/l where "l" = length of the fully extended chain and "d" = the horizontal distance over the reef covered by the conformed chain.

Monitoring Objective	Characteristics to Evaluate	Methods
Structural Stability	Scouring at the base of structures	Tagging individual structures, photo-documentation, data collection, observations throughout the site
	Stability of structures (Stable, loose, detached or missing)	Tagging individual structures, photo-documentation, data collection, observations throughout the site
Coral Recruitment and Colonization	Settlement and survival of coral recruits	Permanent quadrats
	Community composition of biota colonizing the restoration structures	Permanent quadrats, belt transects
Coral Reattachment success	Survival and stability of coral transplants	Tagging individual colonies, photo-documentation, data collection

Table 7: Monitoring objectives and methods to evaluate success of the primary restoration.

4.6.3 Evaluation of Preferred Alternative

The Trustees evaluation of the proposed actions based on the restoration goals for the site and the criteria applicable to planning primary restoration actions identified in Section 4.3 is summarized here.

The proposed restoration project will act to restore and/or accelerate the return of key natural resources and services at the T/V MARGARA site and, in combination, provide an effective approach to accelerating the eventual return of the injured coral resources and reef habitat at the site to baseline conditions. Results from the recruitment monitoring at the T/V MARGARA site over the past 5 years (described in Section 3.4) have shown that recovery is not occurring at the site seven years post-injury. In order for the site to begin recovery, the rubble needs to be stabilized and the topography of the reef needs to be restored as suggested in the scientific literature (in Section 3.4). The proposed primary restoration actions would accomplish both of these objectives: stabilizing the rubble and reconstructing the topography of the reef similar to that found in the surrounding reef.

The quarried limestone rocks that are proposed to be used are the same material as the coral reefs and were themselves coral reefs at one time. Therefore, the proposed material has similar properties to what was present at the site before the grounding occurred and is a more comparable reef material than foreign materials like ceramic, cement only, cement modules or other materials.

Phase 2 of the proposed plan calls for biological enhancement of the restoration site by transplanting corals from the nearby coral nursery and from other "at-risk" sites. This would return corals to the site immediately. This action will accelerate biological recovery of corals at the site ahead of the time full recovery of would occur if recovery relied entirely on natural recruitment as these species take many years, in some instances even decades to recruit and then grow. The proposed plan also calls for the use

of karsted-quality limestone. This material is porous and has a lot of holes, crevices and grooves which promote recruitment of marine organisms as new recruits favor irregular surfaces and crevices that provide protection. Coral recruitment is also not as successful on flat surfaces because the corals get smothered by sedimentation (Maida et al., 1994). Ceramic, cement or other materials lack this characteristic. Samples of limestone were placed at the site by the Trustees in 2010 to test how the material would function at the site. After 3 years, there were high rates of coral recruitment and survival on the limestone (Figure 16) including many broadcast spawners like *Orbicella cavernosa, Diploria strigosa* and *D. labyrithiformis* which typically have lower recruitment rates than other coral species that are brooders (Rylaarsdaam, 1983; Smith, 1992; Vermeij, 2006).

Figure 14: Photos of Scleractinian and Octocoral recruits on limestone deployed at T/V MARGARA site in 2010. Photos by NOAA's Restoration Center, 2013.

Conditions that might limit the success of the proposed restoration actions at the T/V MARGARA site would include storms and swells that could affect the stability of the restoration structures. This is addressed in construction criterion iii (identified in Section 4.6.1) that would require any structures that are not able to be securely anchored to the reef substrate will have a minimum weight of 4 tons to ensure that each structure is of sufficient size and weight to avoid shifting or movement during a storm event producing the maximum expected wave height. This was calculated to be approximately 30 feet by the design wave determination and stability analyses performed by Coastal Planning and Engineering, Inc[8].

[8] This report is entitled "Margara Reef Repair Project, Project Site Wave Data and Reef Repair Stability Analysis" and is included in the AR.

The loss of topographic complexity has serious implications for reef recovery and fish and sea urchin populations in spur-and-groove habitats. Restoration efforts must include re-establishment of the topographic complexity to enhance recruitment and growth of coral species that naturally occur in spur-and-groove habitats (Aronson and Swanson, 1997). High relief areas will not recover rapidly to their former state and may not recover at all without substantial restorative engineering (Precht el al., 2001 NOAA, 2002; Rinkevich, 2005). The primary restoration actions proposed here would create an immediate return of topographic relief that is similar to the profile of the reef pre-injury.

The actions proposed are all technically feasible, capable of being implemented in accordance with applicable laws, regulations, and permits, and are considered as having a high likelihood of success at the T/V MARGARA site, both individually and in combination. The proposed primary restoration actions are similar to work has already been successfully completed on reefs around the world, including at other grounding sites in Florida and Puerto Rico. Further, some work of this nature has already been conducted at the T/V MARGARA site as part of the Emergency Restoration phase. The proposed actions have no potential to effect public health and safety beyond risks to divers and other workers inherent in the nature of the project work. Such risks will be managed and avoided/minimized through planning and measures incorporated in project, site and worker safety practices during implementation. If implemented by the Trustees, the Trustees estimate the costs to carry out the proposed actions will be in the range of $4.5 to $5.5 million. It is also possible for the proposed restoration actions to be implemented by the RP, under the Trustees' oversight, and subject to future monitoring and meeting the performance criteria for these actions. At this time, however, whether the RP will be willing and agree to do so is unknown.

The proposed restoration actions will require permits from the U.S. Army Corps of Engineers (USACOE), the Puerto Rico Environmental Quality Board (PREQB), and PRDNER. The proposed project will also require a permit from PRDNER authorizing the handling of corals and habitat modification. During the public review of this document, the Trustees will coordinate ESA and EFH consultations with NOAA's National Marine Fisheries Service (NMFS) (for listed corals, coral critical habitat, corals proposed for listing, turtles, and whales) and with USFWS (for manatees). The Trustees anticipate the proposed project will also need a water quality certificate from PREQB and Certificate of Consistency with Puerto Rico's Coastal Zone Management Plan.

4.7 EVALUATION OF NO ACTION ALTERNATIVE (NON-PREFERRED)

The Trustees' evaluation of the No Action Alternative is summarized in this section. It reflects consideration of the same factors as applied to consideration of the Preferred Alternative. Under the No Action Alternative, no further primary restoration actions would be undertaken. Under this alternative, recovery at the site would be left entirely to the opportunity for natural recruitment and recovery processes within the site's overall environmental conditions and dynamics, including periodic high wave and energy conditions induced by passing storms. Under the No Action Alternative, monitoring of recovery at the site would still occur. Under this alternative, primary restoration actions would either not take place (i.e., site recovery remains 100% dependent on natural processes) or, if meaningful recovery does not occur though natural processes, could lead to primary restoration actions having to be planned and undertaken in the future.

Available information (from published scientific studies and site specific data) indicates that repeated movement of the large amounts of rubble at the site by wave action and currents during storms will continue to inhibit recruitment survival and recovery at the site if no action is taken. The No Action Alternative does not address this condition, the first criterion found in 15 C.F.R. 990.53, and consequently, cannot meet the second and third criteria in 15 C.F.R. 990.53 either. The No Action Alternative will not provide the conditions necessary for recovery of the injured reef and key natural

resources and services of the reef might never return to baseline. Research in the peer reviewed literature shows that recruitment survival in rubble fields is nonexistent or limited (Fox et al., 2003, Fox, 2004; Precht et al., 2007; Raymundo et al., 2007) and this is supported by data collected since 2008 at the T/V MARGARA site that shows recruitment in the rubble fields is low for octocorals (8-18%) and nonexistent for scleractinians (0%) compared to survival rates in restored and reference areas (40-100%). This data, combined with peer-reviewed literature, emphasizes the need to stabilize the rubble areas at the T/V MARGARA site in order to significantly increase the survivorship of coral recruits so that the site can begin recovery and avoid a potential phase shift in the rubble fields from a benthic community that was previously comprised primarily of corals to an algal dominated community that has no chance of returning to its former community composition, prolonged delay in recovery or even possibly, no recovery whatsoever. Without further action, mobilization of rubble during storm events can be expected to also create additional damage within and outside the impact site, as was seen after Hurricane Dean passed south of Puerto Rico in September 2007. The areas injured at the T/V MARGARA site increased almost 10%, from 6,945 m^2 prior to the storm to 7,541 m^2 after the storm (See Appendix A). The additional injuries were the result of rubble movement and burial of adjacent coral reef areas. The topographic relief/rugosity at the site will not recover to its former state under the No Action Alternative; topographic relief/rugosity may not recover at all without substantial restorative engineering (Precht el al., 2001 NOAA, 2002; Rinkevich, 2005). Thus, the No Action Alternative it is not expected to meet primary restoration goals and objectives and is unlikely to be successful in restoring the site or its key resources and services.

For as long as significant volumes of loose rubble remain at the site, the No Action Alternative has an attendant, on-going likelihood of causing further injuries and losses of resources due to the Incident, both within the current footprint of the impact site and in adjacent areas. For the same reason, this alternative could not avoid collateral injury during implementation. While the No Action Alternative would involve no present expenditures beyond monitoring, if – as the Trustees expect – future monitoring shows a lack of meaningful recovery, primary restoration actions will need to be reconsidered in the future. This alternative will only have delayed recovery, added unnecessary interim losses and delayed the performance of necessary actions, with potential higher costs future costs. The No Action Alternative presents no foreseeable potential to effect public health and safety.

Overall, the Trustees' evaluation shows the No Action Alternative to be a fundamentally poor primary restoration strategy and one that does not support the objectives of primary restoration at this injury site, nor the goal of OPA to ensure that the public will be made whole.

5.0 ENVIRONMENTAL CONSEQUENCES OF PROPOSED ACTIONS

This section of the document specifically addresses the factors and criteria that federal agencies are to consider in evaluating the potential significance of proposed actions in terms of both context and intensity. In the case of a site-specific restoration project, as proposed in this Draft PRP/EA**,** the appropriate context for considering significance of the action is local, as opposed to national or worldwide.

The activities proposed in this Draft PRP/EA include stabilizing loose rubble and limestone, reattaching loose coral fragments, transplanting corals from at-risk areas and attaching nursery-raised corals to the stabilized reef areas. Limestone, large corals and substrate may be reattached or secured by weight (at placement or as constructed) or by using cement, rebar, concrete, nails, and/or epoxy. The placement, reattachment, and stabilization of smaller coral fragments, individual coral colonies, or nursery-reared corals is typically done using epoxy, cement, concrete nails or other mechanical devices (e.g., plastic cable ties). Generally, transplanted corals are reattached either directly to the reef or to a base (limestone, in this instance), which is affixed to the sea floor. Stabilization and restoration activities conducted will use field-tested methods and be performed in a manner that results in only minor temporary adverse effects with a net overall beneficial effect to the corals and coral reefs at and in the vicinity of the T/V MARGARA impact site.

The proposed restoration actions will increase coral recruitment survival to accelerate coral reef recovery at the T/V MARGARA impact site, enhance coral cover at the site and stabilize the rubble areas to prevent additional damage to reef resources during storm events. The restoration actions will increase reef habitat function and topographic complexity at the site. The proposed actions will restore coral reefs and increase their services and benefits to other resources in the waters of southern Puerto Rico. The enhanced and increased reef habitat resulting from these actions will also provide improved (from current conditions) areas for fish, lobster and other marine species to feed and seek protection. Aesthetic and recreational benefits to humans are also possible for divers and fishermen in Puerto Rico.

5.1 ENVIRONMENTAL AND SOCIO-ECONOMIC IMPACTS EVALUATION

The environmental and socio-economic impacts of the described restoration actions are largely beneficial. The actions to be implemented will increase stability and survival of coral recruits at the site, and improve and enhance recovery times for the impacted reef. These effects, in turn, will contribute to improving the overall quality of the coral reef environment off of Guayanilla, allowing for increased populations of corals and other benthic invertebrates, improved habitat for marine organisms, and other benefits for a variety of federally threatened and endangered species. Similar restoration projects have been completed in Florida at a scale similar to that proposed here with no significant adverse effects. As with any restoration action, there are certain short term effects associated with, for example, the use of small vessels, anchoring, placement of structures on the sea floor, and coral tissue contact with cement and epoxy that can be adverse, such as the potential for debris, localized turbidity, isolated mortality, surface damage and added vessel traffic. Effects of this nature are minimized through implementation planning, following best management practices, and utilizing trained and experienced practitioners. Any effects of this nature that do occur are expected to be localized and of very limited duration.

There will be one phase of the proposed restoration project (limestone deployment) during which the Trustees believe there is elevated risk for potential adverse and unanticipated effects. During this period, expected to last less than 30 days, a barge or similar vessel with a crane would transit regularly from a local port (Guayanilla, Ponce, or Tallaboa) with limestone boulders ranging in size up to a maximum of 2 cubic meters. As discussed in Section 3.7 the boulders will be used to stabilize the rubble at the site and

rebuild structural complexity. Once on-site, the crane will be used to place the boulders on the bottom in pre-designated locations. Large boulders will be placed directly at their final planned location; small and moderate boulders will be temporarily cached in the rubble fields or on adjacent sand bottom, to be moved later by divers using lift bags. Because this operation has the greatest potential to result in adverse effects, the Trustees will incorporate a conservative set of Best Management Practices (BMPs) in undertaking the work to ensure resource protection as well as personnel safety during this activity in addition to measures to be applied to all phases of the proposed primary restoration actions. Where appropriate and not otherwise noted, these will include:

- All diving support vessels will use pre-established mooring buoys or diver placed/verified anchor locations.
- The barge and other large vessels assisting in the project are prohibited from dropping anchors and must use pre-established mooring buoys (appropriate for vessel size) or hold position using dynamic positioning.
- Rock boulders of all sizes will be pre-washed onshore to ensure limited transport of small material and sediment that could increase sediment and turbidly at the site. Onshore washing facilities must have appropriate controls (as defined by PREQB) in place to ensure capture of sediment before it enters a water body.
- During all material placement operations (from barge to the seafloor) a wildlife observer will be in place and if marine mammals or sea turtles are noted in the work area operations will cease until it is determined safe to resume.
- All drop zones will be marked with both surface and subsurface markings that correspond to a location on the map and within the operational plan. Additional sensitive reef areas will be marked utilizing a different set of surface and subsurface markers.
- All personal involved in the project will be trained on reef impact avoidance and will be briefed on a daily basis about specific tasks to be performed, areas to be avoided, and potential risks associated with the day's operations.
- Divers should verify all material placements prior to vessel moving offsite.
- All material will be placed on the bottom in a controlled manner (lift bags, lines, or cables) and will not be allowed to free fall at any time.
- Operations will be suspended anytime any visible turbidity (resulting from project operations) extends beyond the localized area and/or moves towards any marked sensitive areas.

As with all restoration projects, sound evaluation criteria, project performance goals, capacity for adaptive management, and appropriate risk considerations are key for successful implementation. Minor adjustments to these plans may need to be made on site based on any combination of these factors. The Trustees will have a monitor on-site at the beginning and end of all operational phases to assess the efficacy of BMP's and institute appropriate adaptive management measures as necessary to minimize any potential adverse effects to resources.

The proposed primary restoration project will have only positive impacts in the local community. Both recreational and commercial fisheries in the Guayanilla area have the potential to indirectly benefit as the proposed actions will improve habitat in the system that many economically important species of finfish and invertebrates rely on during various life stages.

5.2 IMPACTS OF PREFERRED ALTERNATIVE AND NO ACTION ALTERNATIVE

The Trustees evaluated the potential for restoration actions associated with both the Preferred and the No Action Alternatives to impact the following: biological resources (fisheries, vegetation and wildlife, and endangered species), air and noise pollution, water quality, geological and energy resources,

contaminants, and socio-economics (environmental justice, recreation, traffic, and cultural resources) and considered the potential for cumulative impacts as well.

Fisheries: The preferred alternative for restoration would be within areas designated as Essential Fish Habitat (EFH), but the Trustees do not believe that the proposed restoration actions will have an adverse impact on EFH as designated under the Magnuson-Stevens Fishery Conservation and Management Act, as amended and reauthorized by the Sustainable Fisheries Act (Public Law 104-297) (Magnuson Stevens Act), 16 U.S.C. §§1801 et seq. Prior to the grounding injury, the site provided valuable EFH. However, its current condition (loose unconsolidated rubble that was left behind; no topography; areas devoid of biota) is not EFH. Stabilizing the rubble and re-introducing both topographic features and biota to restore the site's EFH would benefit the surrounding fisheries. The entire restoration project will likely last up to 90 days with 1-2 vessels going to the site per day. Vessels and companies contracted for this work will be required to have all the insurances and USCG certifications to minimize and be able to respond to any spills or release of lubricants. The vessels used will likely range from 30-70' in length and be based out of Ponce Marina. It is common for seas in the transit lanes between Ponce marina and the T/V MARGARA restoration site to reach 6 - 8'+. Mangroves and seagrass beds in the area are protected from offshore swells by coral reefs. Compared to normal environmental conditions at the restoration site (which is 30-50' deep) and along the transit lanes, wakes from the vessels will not exceed typical background conditions so they should have no impact on coral reefs, mangroves or seagrasses in the area.

During the active restoration phase of this project, short-term and very localized adverse impacts that could occur include physical impacts to adjacent coral reefs by anchoring vessels or lowering limestone boulders onto reef, and increases in turbidity within and near the project site during construction. These effects will be minimized by requiring that the contractors set up temporary moorings so vessels won't have to anchor, lowering limestone into sandy areas identified by surface buoys placed by divers prior to deployment and using a sludgy stucco-like cement mixture that reduces pluming that will be employed in undertaking restoration actions to maximize the protection of area resources but some increase in turbidity could still occur. Increases in turbidity may affect coral, fish and filter feeders in the local area, by clogging gills, increasing mucus production and smothering organisms found on reefs in the vicinity. Mobile fish and invertebrates would probably not be affected, since these would most likely leave the area, and return after project completion. Increased noise levels due to vessel traffic would also cause mobile fish to leave the area until operations end. The EFH would be positively impacted by the accelerated recovery and enhancement of reef services that will be achieved through the proposed restoration actions, including through increased survival of coral recruits and by preventing additional injuries and losses to reef organisms from rubble mobilization during storm events. The restored reef will serve as habitat for prey species for a variety of managed fish species and provide a nursery for the larvae and juvenile stages of many managed species.

The Trustees believe that the No Action Alternative will have a net adverse impact on EFH as designated under the Magnuson-Stevens Fishery Conservation and Management Act, as amended and reauthorized by the Sustainable Fisheries Act (Public Law 104-297) (Magnuson Stevens Act), 16 U.S.C. §§1801 et seq. EFH would be negatively impacted by a lack of recovery and reduction of reef services that will occur if no action is taken to restore this reef. This includes little to no survival of coral recruits and additional injuries and losses to reef organisms from rubble mobilization during storm events.

Vegetation and Wildlife: The Trustees do not believe that the proposed preferred primary restoration actions will have a net adverse effect on vegetation and wildlife. There is no vegetation present at the site. Any wildlife such as marine mammals that may be present in the area during restoration activities are mobile enough that they would move out of the way of any restoration activity. There is adequate habitat adjacent to the area so they will have plenty of space for refuge during operations.

The Trustees do not believe that the No Action Alternative will have a net adverse effect on vegetation and wildlife.

Endangered Species: Endangered and threatened species are known to occur on reefs in Puerto Rico are listed in Table 8. Many of these species, including staghorn (*Acropora* cervicornis) and elkhorn (*A. palmata*) coral, mountainous star coral (*Orbicella faveolata*), boulder star coral (*O. franksii*), lobed star coral *(O. annularis)*, pillar coral (*Dendrogyra cylindrus)*,rough cactus coral (*Mycetophillia ferox*), green sea turtle (*Chelonia mydas*), Hawksbill turtle (*Lepidochelys kempi*), leatherback turtle (*Caretta caretta*), Scalloped Hammerhead shark (*Sphyrna lewini*), Nassau grouper (*Epinephelus striatus*) and West Indian manatee (*Trichechus manatus*) have been documented on reefs near Guayanilla, Puerto Rico. Most species would either be present on the reef or migrate through the area. Not all of the species that are listed in Table 7 are present near the T/V MARGARA site. Recent surveys of the area indicate the presence of *A. cervicornis, O. faveolata, O. franksii, O. annularis, D. cylindrus*, and *M. ferox*) near the T/V MARGARA grounding site. Each of these species is listed as "Threatened" under ESA; however, none of the listed or proposed corals are found within the area to be restored.

Common Name	Scientific Name	Status
Staghorn coral	*Acropora cervicornis*	T; Critical Habitat
Elkhorn coral	*Acropora palmata*	T; Critical Habitat
Mountainous star coral	*Orbicella faveolata*	T
Boulder star coral	*Orbicella franksii*	T
Lobed star coral	*Orbicella annularis*	T
Pillar coral	*Dendrogyra cylindrus*	T
Rough cactus coral	*Mycetophillia ferox*	T
Green Sea Turtle	*Chelonia mydas*	T; Critical Habitat
Leatherback Turtle	*Dermochelys coriacea*	E; Critical Habitat
Hawksbill Turtle	*Eretmochelys imbricate*	E; Critical Habitat
Roseate Tern	*Sterna dougalii dougalii*	T
West Indian Manatee	*Trichechus manatus*	E
Scalloped Hammerhead shark	*Sphyrna lewini*	T
Nassau grouper	*Epinephelus striatus*	Proposed listing

Table 8: Federal and State Endangered or Threatened Species in waters or on reefs near Guayanilla, Puerto Rico. T = currently listed as Threatened. E = currently listed as Endangered.

The spawning season for these corals is during late summer (August and September). Restoration activities will not be performed during peak hurricane season (Mid-July through Mid-October); therefore the activities will not have an effect on spawning activities. Given the constant presence of tugboats and tankers in the Guayanilla area, the 30-70' boats used during restoration should not have vessel noise signatures that exceed levels experienced frequently at the site. Additionally, the general locale where the restoration actions would be sited is critical habitat for these species. These species will benefit from restoration at the site. Recruitment survival would increase as a result of rubble stabilization. Rubble stabilization would also prevent additional injuries to colonies from mobilization of rubble during storm events that can break, abrade and smother colonies adjacent to the impact site. While it is possible there may be some minor short-term adverse effects to some of these species during primary restoration through sedimentation or from possible physical impact it is not expected. Additionally the overall (net) long-term effects will be much more beneficial to these species and outweigh any of the short-term potential impacts. The Trustees know of no other direct or indirect impacts of the proposed restoration actions on threatened or endangered species, or their designated critical habitats.

The NOAA Restoration Center completed Programmatic Consultation on their enhancement and restoration activities in September 2011 (NMFS, 2011). The Programmatic Biological Opinion analyzed the potential routes of effects from the activities to be implemented under the Preferred Alternative on all listed species and designated critical habitats under NMFS' purview (i.e., corals and sea turtles) listed at the time. The NOAA Restoration Center requested concurrence with NMFS Southeast Protected Resources Division that the Preferred Alternative falls within the scope of the Programmatic Biological Opinion on July 2, 2014; and the Protected Resources Division provided concurrence on July 23, 2014. Since that time NMFS has decided to list an additional five corals as threated under the endangered species act. While some of these corals are present near the Margara site none are within the restoration or impact area, nor has critical habitat for these corals been designated. Nonetheless the Trustees intend to reinitiate a programmatic consultation on our enhancement and restoration activities at this site and others prior to the initiation of construction. The Trustees know of no other direct or indirect impacts of the proposed restoration actions on threatened or endangered species, or their designated critical habitats.

The No Action Alternative would have a net adverse effect on ESA species listed in Table 7 that are either present on the reef or migrate through the area as discussed in the previous section. There will continue to be little or no recruitment survival in the rubble areas. Additional injuries will occur through mobilization of rubble during storm events that can break, abrade and smother colonies adjacent to the impact site.

Air Quality: Minor temporary adverse impacts to air quality would result from exhaust emissions from vessels used during the proposed construction activities; but the amounts would be small, and should be quickly dissipated by prevailing winds. There would be no long-term negative impacts to air quality.

There will be no negative impacts to air quality from the No Action Alternative.

Noise: Noise associated with the vessels represents a short-term adverse impact during the proposed restoration project. There is marine life present at the site, and it is possible that vessels and divers may temporarily disturb marine life in the immediate vicinity, or cause temporary movement of marine life away from the site. Similarly, though the site does not support much if any active recreation by humans (fishermen or divers), it is possible that some people may avoid this area during restoration, but as with marine life, such disruption will be limited to the duration of the project. There are plenty substitute sites readily available to divers and fishermen in Puerto Rico. Installation activities, equipment operation, and vehicle or boat traffic associated with the restoration could result in short-term minor to major adverse impacts to noise in natural areas. For example, during the use of motorized heavy equipment such as

cranes and barges, noise would be created which could be readily apparent and attract attention. Although such changes would not dominate the soundscape and some sounds would be dampened or masked by ambient wave or ship noise, these actions could detract from the current user activities or experiences and create audible contrast for visitors in the project area. While there will be an increase in motorized vessels during the 90 day restoration period, long-term minor impacts to ambient noise levels would only occur during monitoring events when motorized vessels conduct follow up visits to the site which would be a maximum of five days a year for up to ten years.

There will be no negative impacts from noise due to the No Action Alternative.

Water Quality: In the short term, the proposed construction activities might temporarily increase turbidity in waters within and near the project site. These effects will be minimized through BMPs that will be employed in undertaking restoration actions but some turbidity could still occur. Implementation of similar past restoration projects have been shown to have little to no effects on the adjacent reef. Over the longer term, the proposed restoration actions will accelerate recovery of and enhance coral reefs at the site.

There may be an increase in turbidity in waters within and near the T/V MARGARA site as a result of No Action, particularly when sediment in the rubble fields is suspended during storms.

Geology: The proposed restoration actions will have a positive impact on the reef geology. The T/V MARGARA had a significant impact on reef topography and flattened the reef in many areas, particularly the rubble areas. Without restoration, these areas may never recover their original topography. The restoration proposed here will have an immediate positive effect by restoring topographic complexity to the site.

The No Action Alternative will have a negative impact on the reef geology in the area. The T/V MARGARA had a significant impact on reef topography and flattened the reef in many areas, particularly the rubble areas. With No Action, these areas may never recover their original topography.

Energy: Natural gas and petroleum products are transported by vessels almost daily to nearby facilities in Guayanilla and Tallaboa, Puerto Rico. The proposed restoration activities will take place outside of the shipping channels intended for transport of these products, in waters too shallow for such vessel to safely travel. None of the proposed restoration actions at the T/V MARGARA site have the potential to directly or indirectly affect energy production, transport, or infrastructure in Puerto Rico in any way.

The No Action Alternative does not have the potential to directly or indirectly affect energy production, transport, or infrastructure in Puerto Rico in any way.

Contaminants: The Trustees have no reason to believe there are any contaminants of concern at the proposed restoration site. The T/V MARGARA site and the surrounding reef area have been investigated extensively as part of preassessment, emergency restoration, assessment surveys used to identify impacted reef areas and identify necessary restoration actions. These previous efforts have included removal of remnant anti-fouling paint from the T/V MARGARA Incident whenever found. These investigations did not identify any additional contaminants of concern in the area.

Environmental Justice: None of the proposed restoration activities have the potential to negatively and/or disproportionately affect minority or low-income populations in Puerto Rico, including economically, socially, or in terms of conditions affecting their health. Coral reef restoration projects have been

implemented in Puerto Rico consistent with federal, state and local laws designed to protect and restore the environment. The proposed restoration project has no unique attributes or characteristics in that regard. The proposed activities will help restore an environment that is of benefit to all citizens, populations and groups in Puerto Rico.

By taking No Action, the damaged reef environment that is of benefit to all citizens, populations and groups in Puerto Rico may never recover. The lack of meaningful recovery of the reef contributes negatively to the economic and social well-being of all citizens, populations and groups in Puerto Rico, especially those in the Guayanilla area, although it would not expected to impact conditions affecting their health. Minority or low-income populations in Puerto Rico are potentially negatively impacted by the No Action Alternative to the same extent as all other citizens.

Recreation: Though noise and increased turbidity of surface waters due to construction activities during restoration can temporarily discourage and decrease recreational activities in the vicinity of a site, this site does not currently support much if any active recreation. Nonetheless, it is possible that some persons may avoid this area due to noise during construction, but such disruption would be minor and limited to the duration of the restoration activities. There are many other sites readily available in the Guayanilla area that are similar, or better quality, substitute sites for recreation. In the longer term, the proposed restoration actions are expected to increase and enhance the site's post-incident aesthetics and recreational opportunities for fishermen and divers in the Guayanilla area.

The No Action Alternative could negatively impact recreational opportunities for fishermen and divers in the Guayanilla area since the impacted reef may never recover with No Action. This would result in a reduction in available fishing and diving areas.

Traffic: Vessel traffic will occur and be increased at the site during active implementation of the restoration activities. There is vessel traffic in the adjacent waters, including large vessel traffic associated with transport of natural gas and petroleum products, but the proposed restoration activities will take place outside of the primary routes, channels and areas used by vessels. Vessels used to implement restoration at the site will display appropriate dive flags to alert other vessels that mobility at the site is restricted during restoration. Once restoration activities are complete, the added vessel traffic to, from and at the restoration site will end. No other effects on traffic in the area are anticipated.

The No Action Alternative will have no effect on traffic in the area.

Cultural Resources: There are no known historic sites or significant cultural, scientific or historic resources in the areas that will be affected by the proposed restoration actions. Archeologists from the Cultural Institute of Puerto Rico visited the T/V MARGARA site in December, 2013 and confirmed in writing (letter posted in the AR) that there are no areas or resources of cultural or historical significance that will be disturbed by the proposed restoration actions.

Cumulative Impacts of the Preferred Primary Restoration Alternative:

The proposed Preferred Primary Restoration Alternative is expected to result in cumulative, positive impacts by accelerating recovery and enhancing the coral reef at this site, allowing it to provide ecological services sooner and into the future. The effects of the proposed primary restoration project, however, are local and are not expected to significantly affect the human environment alone or in combination with other reef restoration projects in its vicinity. It will not result in any change in the larger current pattern of hydrologic discharge, boat traffic, economic activity or land-use in Guayanilla, Puerto Rico. The proposed restoration actions will only restore habitat that originally existed and occurred naturally at this location. The effects of the proposed primary restoration activities at the T/V

MARGARA site will be considered in the future in considering the cumulative effects of additional compensatory restoration activities that are proposed to compensate the remaining losses caused by and to make the public and the environment whole for the rest of the coral resource injuries and losses caused by the T/V MARGARA grounding.

Other known activities in the vicinity of the primary restoration include the commercial shipping lane nearby, which has routine marine vessel traffic. It is not likely the restoration will have any additive effects to commercial marine vessel traffic, or vice versa, since the coral reef is outside of the shipping lane. A local coral nursery was developed as a result of this grounding, and is expected to continue to operate as a coral grow-out nursery after the proposed restoration action has been completed. The coral species produced at the nursery are used in nearby areas for other coral recovery and restoration projects, to benefit ongoing coral resource conservation efforts. The nearest other grounding site requiring similar restoration was about 60 miles away, but was at the southeast corner of Puerto Rico. This is not really close enough to have either beneficial or adverse additive impacts to the coral reef located at the proposed restoration site. There are commercial fisheries in the vicinity, for finfish and shellfish (not for corals). The level of this fishing activity has been steady but some preliminary indications are that it may increase once the restored condition at the MARGARA grounding site is realized.

Overall, there are likely to be no significant adverse cumulative impacts from the proposed action. A net cumulative beneficial impact may result from future restoration activities that may be used to compensate for interim losses, however, those restoration actions have not yet been determined. At this time, it is not possible to predict what the level of interim restoration needed will be, and therefore, what the potential cumulative impacts from it would be relative to the potential impacts from the proposed primary restoration. The consideration and evaluation of the potential impacts of future compensatory restoration activities can occur only after the primary restoration plan is completed and the nature and scope of the primary restoration to be implemented is known as this will inform planning and identification of the future compensatory actions.

The preferred Primary Restoration Alternative proposed in this Draft PRP/EA is based on restoration work conducted in Puerto Rico over the last ten years. Prior restoration efforts have shown that a comprehensive approach that includes both structural and biological components has the most success over the long term compared with the approach of taking no action or only partly addressing the underlying environmental problems. The trend of coral reef decline in the Caribbean and the rest of the world over the last few decades make existing coral reef resources even more vulnerable as well as more valuable, increasing both the need and urgency for both primary restoration and conservation.

Cumulative Impacts of the Non-Preferred (No Action) Alternative

The No Action Alternative is expected to result in cumulative, negative impacts and would not provide the conditions necessary for recovery of the injured reef. With No Action, key natural resources and services might not ever return to baseline. For as long as significant volumes of loose rubble remain at the site, the No Action Alternative has an attendant, on-going likelihood of causing further injuries and losses of resources due to the Incident, both within the current footprint of the impact site and in adjacent areas. While the Non-Preferred Alternative would not have any negative effects on air, noise, traffic, energy, cultural resources, vegetation and wildlife, there would be negative effects on fisheries, endangered species, geology, water quality, recreation and socio-economic factors. The loss of the injured coral reef resources into perpetuity would have a significant impact on the amount of compensatory restoration required to compensate the remaining losses caused by and to make the public and the environment whole for coral resource injuries and losses caused by the T/V MARGARA grounding. Data collected at the site, the scientific literature and restoration work conducted in Puerto Rico over the last ten years has shown that these rubble areas will not recover with No Action. The

current trend of coral reef decline over the last few decades only adds to the urgency for primary restoration and the need to take action at the T/V MARGARA site.

6.0 COMPLIANCE WITH OTHER KEY STATUTES, REGULATIONS AND POLICIES

***Clean Water Act (CWA), 33 U.S.C. § 1251* et seq.**
The CWA is the principal law governing pollution control and water quality of the nation's waterways. Section 404 of the law authorizes a permit program for the beneficial uses of dredged or fill material. The U. S. Army Corps of Engineers administers the program. Coral restoration projects usually involve placement of materials like limestone and minor disturbances of benthic sediments in jurisdictional waters, and therefore require 404 permits. Under Section 401 of the CWA, restoration projects that involve discharge or fill activities in navigable waters must obtain certification of compliance with state water quality standards. All necessary 404 permits and 401 certifications will be obtained by either NOAA or the contractors that will be conducting the operation for proposed project activities prior to implementation.

***Rivers and Harbors Act, 33 U.S.C. § 401* et seq.**
The Rivers and Harbors Act regulates development and use of the nation's navigable waterways. Section 10 of the Act prohibits unauthorized obstruction or alteration of navigable waters and vests the U. S. Army Corps of Engineers with authority to regulate discharges of fill and other materials into such waters. Restoration actions that must comply with the substantive requirements of Section 404 must also comply with the substantive requirements of Section 10. This requirement will be addressed for project activities prior to implementation as part of processes used in CWA 404 permitting.

Coastal Zone Management Act (CZMA), 16 U.S.C. § 1451* et seq.*, 15 C.F.R. Part 923
The goal of the CZMA is to encourage states to preserve, protect, develop, and, where possible, restore and enhance the nation's coastal resources. Under Section 1456 of the CZMA, restoration actions undertaken or authorized by federal agencies within a state's coastal zone are required to comply, to the maximum extent practicable, with the enforceable policies of a state's federally approved Coastal Zone Management Program. The Trustees believe that the proposed restoration actions are consistent with the Puerto Rico Coastal Zone Management Program. NOAA will be submitting this consistency determination to the PR CZMP for review and concurrence prior to implementation of primary restoration.

Endangered Species Act (ESA), 16 U.S.C. § 1531* et seq.*, 50 C.F.R. Parts 17, 222, & 224
The ESA requires all federal agencies to conserve endangered and threatened species and their habitats to the extent their authority allows. Under the ESA, the Department of Commerce (through NOAA's National Marine Fisheries Service), and the Department of the Interior (through USFWS) publish lists of endangered and threatened species. Section 7 of the Act requires federal agencies to consult with these departments to minimize the effects of federal actions on these listed species.

As summarized in subsection 4.2 above, the Trustees believe none of the actions proposed in this Draft PRP/EA to restore impacted coral reefs at the T/V MARGARA site are likely to adversely affect Threatened or Endangered Species or their designated critical habitats. NOAA Restoration Center has requested concurrence with NMFS Southeast Protected Resources Division that the Preferred Alternative falls within the scope of the Restoration Centers Programmatic Biological Opinion on July 2, 2014; and the Protected Resources Division provided concurrence on July 23, 2014.

***Fish and Wildlife Conservation Act, 16 U.S.C. § 2901* et seq.**
The proposed restoration actions will either encourage the conservation of non-game fish and wildlife, or have no adverse effect.

***Fish and Wildlife Coordination Act (FWCA), 16 U.S.C. § 661* et seq.**
The FWCA requires that federal agencies consult with the USFWS, NMFS and state wildlife agencies regarding activities that affect, control, or modify waters of any stream or bodies of water, in order to minimize the adverse impacts of such actions on fish and wildlife resources and habitat. The Trustees are coordinating with NMFS, the USFWS, and the Puerto Rico Department of Natural Resources (the appropriate state wildlife agency under FWCA). This coordination is also incorporated into compliance processes used to address the requirements of other applicable statutes, such as Section 404 of the CWA. The restoration actions described herein will have a positive effect on fish and wildlife resources.

***Magnuson-Stevens Fishery Conservation and Management Act, as amended and reauthorized by the Sustainable Fisheries Act (Public Law 104-297) (Magnuson-Stevens Act), 16 U.S.C. §§1801* et seq.**
The Magnuson-Stevens Act provides for the conservation and management of the Nation's fishery resources within the Exclusive Economic Zone (from the seaward boundary of every state to 200 miles from that baseline). The resource management goal is to achieve and maintain the optimum yield from U.S. marine fisheries. The Act also established a program to promote the protection of Essential Fish Habitat (EFH) in the review of projects conducted under federal permits, licenses, or other authorities that affect or have the potential to affect such habitat. After EFH has been described and identified in fishery management plans by the regional fishery management councils, federal agencies are obligated and other agencies are encouraged to consult with the Secretary of Commerce with respect to any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken by such agency that may adversely affect any EFH.

As summarized in subsection 5.2 above, the Trustees do not believe that the proposed restoration actions will have a net adverse impact on EFH as designated under the Act. An abbreviated EFH consultation was initiated with NMFS in June 2014 and they do not consider the site in its current condition (loose unconsolidated rubble that was left behind; no topography; areas devoid of biota) as EFH. Correspondence from NMFS personnel regarding this determination will be included in the Final PRP/EA, as well as the administrative record.

***Marine Mammal Protection Act, 16 U.S.C. § 1361* et seq.**
The Marine Mammal Protection Act provides for the long-term management of and research programs for marine mammals. It places a moratorium on the taking and importing of marine mammals and marine mammal products, with limited exceptions. The Department of Commerce is responsible for whales, porpoise, seals, and sea lions. The Department of the Interior is responsible for all other marine mammals. The proposed restoration actions will not have an adverse effect on marine mammals.

***Migratory Bird Conservation Act, 16 U.S.C. § 715* et seq.**
The proposed restoration actions will have no adverse effect on any migratory birds.

Migratory Bird Treaty Act, 16 U.S.C. § 703 – 712
The proposed restoration actions will have no adverse impacts on migratory birds under the purview of this Act. No migratory birds will be pursued, hunted, taken, captured, killed, attempted to be taken, captured or killed, possessed, offered for sale, sold, offered to purchase, purchased, delivered for shipment, shipped, caused to be shipped, delivered for transportation, transported, caused to be transported, carried, or caused to be carried by any means whatever, received for shipment, transported or carried, or exported, at any time, or in any manner.

***National Historic Preservation Act, 16 U.S.C. § 470* et seq.**
Section 106 of the NHPA requires federal agencies, or federally funded entities, to consider the impacts of their projects on historic properties. NHPA regulations require that federal agencies take the lead in this process, and outline procedures to allow the Advisory Council on Historic Preservation to comment on any proposed federal action. The Trustees are presently unaware of any historic sites or resources that could be affected by the proposed restoration actions. Archeologists from the Cultural Institute of Puerto Rico visited the T/V MARGARA site in December, 2013 and confirmed that there are no areas or resources of cultural or historical significance that will be disturbed by the proposed restoration actions.

Information Quality Guidelines Issued Pursuant to Public Law 106-554
Information disseminated by federal agencies to the public after October 1, 2002, is subject to information quality guidelines developed by each agency pursuant to Section 515 of Public Law 106-554 that are intended to ensure and maximize the quality of such information (i.e., the objectivity, utility and integrity of such information). This Draft PPRP/EA is an information product covered by information quality guidelines established by NOAA and DOI for this purpose. The quality of the information contained herein is consistent with the applicable guidelines.

Executive Order 12898 (59 Fed. Reg. 7629) -Environmental Justice
This Executive Order requires each federal agency to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations. EPA and the Council on Environmental Quality have emphasized the importance of incorporating environmental justice review in the analyses conducted by federal agencies under NEPA and of developing mitigation measures that avoid disproportionate environmental effects on minority and low-income populations. The restoration alternatives proposed in this Draft PRP/EA has no potential to affect any low income or ethnic minority communities, therefore the Trustees have concluded that such communities would not be adversely affected by the proposed restoration actions.

Executive Order Number 11514 (35 Fed. Reg. 8,693) – Protection and Enhancement of Environmental Quality
A Draft Environmental Assessment is integrated within this Draft PRP/EA and environmental analyses and coordination are taking place as required by NEPA.

Executive Order Number 11988 (42 Fed. Reg. 26,951) – Floodplain Management
The proposed restoration actions have neither bearing on development of nor any other potential to affect any floodplain.

Executive Order Number 11990 (42 Fed. Reg. 26,961) -Protection of Wetlands
The proposed restoration actions will not result in adverse effects on wetlands or the services they provide.

Executive Order Number 12962 (60 Fed. Reg. 30,769) -Recreational Fisheries
The proposed restoration actions will not result in adverse effects on recreational fisheries but will contribute to the enhancement of, and help support, such fisheries.

Regulation 2577, Commonwealth of Puerto Rico
Article 3 in Regulation 2577 of 5 November 1979, *Regulation to control the extraction, possession, transportation and sale of coralline resources in Puerto Rico*, prohibits to take, extract, destroy, transport, possess or sale any live or dead coral within state waters. Article 5.4 of this regulation exempts of this prohibition those activities that have a US Corps of Engineers permit and have an endorsement from the

Department of Natural and Environmental Resources. Thus, the restoration activities proposed in the Draft PRP/EA are required to obtain a COE permit and an endorsement from DNER prior to beginning the activities. These requirements will be addressed prior to implementation of proposed activities through or coincident with CWA 404 permitting.

Regulation 6766, Commonwealth of Puerto Rico

Regulation 6766 of 11 February 2004, *Regulation to rule threatened and endangered species of the Commonwealth of Puerto Rico,* prohibits the possession, transportation, take or destruction of threatened or endangered species without a DNER's Secretary permit (Article 2.02). The Secretary could provide a permit or authorization letter for activities that will result in the reproduction or survival of the species (Article 5.02). The restoration activities proposed in the Draft PRP/EA seek to increase the survival of coral species considered at present threatened so the Trustees do not expect impediments in the process of obtaining such authorization or permit.

Regulation 6765, Commonwealth of Puerto Rico

Regulation 6765 of 11 February 2004, *Regulation to rule the conservation and management of wildlife, exotic species and hunting activity in the Commonwealth of Puerto Rico,* prohibits the possession, transportation, take or destruction of wildlife without a DNER's Secretary permit (Article 2.02). Given that the Regulation and the DNER system do not provide a process for this type of activity, an authorization letter must be requested for handling the wildlife. The Draft PRP/EA seeks to increase the survival and propagation of coral species so the Trustees do not expect impediments in the process of obtaining such authorization or permit.

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9.0 REFERENCES

Aronson, R.B., Sebens, K.P., and Ebersole, J.P. 1994. Hurricane Hugo's Impact on Salt River Submarine Canyon, St. Croix, US Virgin Islands. In: Ginsburg RN (ed) Proc Colloquium on Global Aspects of Coral Reefs: Health, Hazards, and History. Rosenstiel School of Marine and Atmospheric Science, Miami. 189-195.

Becker, L.C. and Mueller, E. 2001. The culture, transplantation and storage of *Montastraea faveolata, Acropora cervicornis* and *Acropora palmata*: what we have learned so far. Bulletin of Marine Science. 69: 881-896.

Blanchon, P., Jones, B., and Kalbfleisch, W. 1997. Anatomy of a Fringing Reef Around Grand Cayman: Store Rubble, Not Coral Framework. J. Sed. Research. 67 (1): 1-16.

Bowden-Kerby, A. 1998. Coral Transplantation in Sheltered Habitats. Proceedings of the 8th International Coral Reef Symposium. 2: 2063-2068.

Brander, L.M., Van Beukering, P., and Cesar, H.S.J. 2007. The recreational value of coral reefs - A meta analysis. Ecological Economics 63:209-218.

Bruckner AW (2002) Proceedings of the Caribbean Acropora Workshop. Potential application of the U.S. Endangered Species Act as a conservation strategy: April 16-18, 2002, Miami, Florida. NOAA Technical Memorandum. NMFS-OPR-24 Silver Spring, MD. p 184

Buddemeier, R.W., Smith, S.V., and Kinzie, R.A. 1975. Holocene Windward Reef-Flat History, Enewak Atoll. Geological Society of America Bulletin. 86: 1581-1584.

Burke, L. and Maidens, J. 2004. Reefs at Risk in the Caribbean. Washington, DC: World Resources Institute.

Cesar, H.J.S., Burke, L., and Pet-Soede, L. 2003. The Economics of Worldwide Coral Reef Degradation. Cesar Environmental Economics Consulting, Arnhem, and WWF-Netherlands, Zeist, The Netherlands. 23 pp.

Cox, E. F. 1992. Fragmentation in the Hawaiian Coral *Montipora Verrucosa*. Proceedings of the 7th International Coral Reef Symposium (Guam). 1: 513-516.

Estudios Técnicos, Inc. 2007. Valoración económica de los arrecifes de coral y ambientes asociados en el Este de Puerto Rico: Fajardo, Arrecifes La Cordillera, Vieques y Culebra. Final Report. 101 pp.

Fox, H.E. 2004. Coral Recruitment in Blasted and Unblasted Sites in Indonesia: Assessing Rehabilitation Potential. Marine Ecology Prog. Ser. 269: 131-139

Fox, H.E., Pet, J.S., Dahuri, R., and Caldwell, R.L., 2003. Recovery in Rubble Fields: Long Term Impacts from Blast Fishing. Marine Pollution Bulletin. 46: 1024-1031.

Griffin, S.P., Spathias, H., Moore, T.D., Baums, I. and Griffin, B.A. (2012) *Scaling up Acropora nurseries in the Caribbean and improving techniques.* Proceedings of the 12th International Coral Reef Symposium

Griffin, S.P. and Moore T.D. 2011. Case Study 5: *Acropora cervicornis* Restoration at the T/V MARGARA grounding site in Puerto Rico. Caribbean *Acropora* Restoration Guide. The Nature Conservancy. Pages 40-41

Gittings, S.R., Bright, T.J., Choi, A., and Barnett, R.R. 1988. The Recovery Process in a Mechanically Damaged Coral Reef Community: Recruitment and Growth. Proceedings of the 6th International Coral Reef Symposium. 2:225-230.

Harborne, A.R., Mumby, P.J., Miceli, F., Perry, C.T., Dahlgren, C.P., Holmes, K.E., and Daniel, R.B. 2006. The functional value of Caribbean coral reef, seagrass and mangrove habitat to ecosystem processes. Advances in Marine Biology. 50:57-189.

Highsmith, R.C., Lueptow, R.L., and Shonberg, S.C. 1983. Growth and Bioerosion of Three Massive Corals on the Belize Barrier Reef. Marine Ecology and Progress Series. 13: 261-271.

Hollarsmith, J.A., Griffin, S.P., and Moore, T.D. (2012) The success of *Acropora cervicornis* outplants in reef restoration. Proceedings of the 12th International Coral Reef Symposium

Hubbard, D.K. and Scaturo, D. 1985. Growth Rates of Seven Species of Scleractinean Corals from Cane Bay and SALT River, St. Croix, USVI. Bulletin of Marine Science. 36 (2): 335-348.

Hudson, J.H. and Goodwin, W.B. 1997. Restoration and Growth Rate of Hurricane Damaged Pillar Coral (*Dendrogyra cylindrus*) in the Key Largo National Marine Sanctuary, Florida.

Lirman, D. and Miller, M.W. 2003. Modeling and Monitoring Tools to Assess Recovery Status and Convergence Rates Between Restored and Undisturbed Coral Reef Habitats. Restoration Ecology. 11 (4): 448-456.

Maida, M., Coll, J.C., and Sammarco, P.W. 1994. Shedding New Light on Scleractinian Coral Recruitment. Journal of Experimental Marine Biology and Ecology. 180: 189-202.

Miller, M. and Barimo, J. 2001. Assessment of Juvenile Coral Populations at Two Reef Restoration Sites in the Florida Keys National Marine Sanctuary: Indicators of Success? Bulletin of Marine Science. 69(2):395-405.

Milon, J.W. and Dodge, R.E. 2001. Applying Habitat Equivalency Analysis for Coral Reef Damage Assessment and Restoration. Bulletin of Marine Science. 69 (2): 975-988.

Moberg, F. and Folke, C. 1999. Ecological goods and services of coral reef ecosystems. Environmental Economics 29:215-233.

Muñoz-Chagín, R.F. 1998. Coral Transplantation Program in the Paraiso Coral Reef, Cozumel Island, Mexico. Proceedings of the 8th International Coral Reef Symposium. 2: 2075-2077.

NOAA – Marine Sanctuaries Division. 2002. Environmental Assessment: *M/V Wellwood* Grounding Site Restoration. Florida Keys National Marine Sanctuary. Monroe County, Florida.

Precht, W.F., Aronson, R.B., and Swanson, D.W. Improving Scientific Decision-Making in the Restoration of Ship-Grounding Sites on Coral Reefs. Bulletin of Marine Science. 69 (2). 1001-1012.

Precht, W.F., Deis, D.R., and Gelber, A.R. 2002. Damage Assessment Protocol and Restoration of Coral Reefs Injured by Vessel Groundings. Proceedings of the 9th International Coral Reef Symposium. 2:963-968.

Rasser, M.W. and Riegl, B. 2002. Holocene Coral Reef Rubble and its Binding Agents. Coral Reefs. 21:57-72.

Raymundo, L.J., Maypa, A.P., Gomez, E.D., and Pablina, C. 2007. Can Dynamite-Blasted Reefs Recover? A Novel, Low-Tech Approach to Stimulating Natural Recovery in Fish and Coral Populations. Marine Poll Bulletin. 54 (7): 1009-1019.

Riegl, B. and Luke, K.E. 1998. Ecological Parameters of Dynamited Reefs in Northern Red Sea and the Relevance to Reef Habilitation. Marine Poll Bulletin. 37: 488-498.

Rinkevich, B. 2005. Conservation of Coral Reefs Through Active Restoration Measures: Recent Approaches and Last Decade Progress. Environmental Science and Technology. 39: 4333-4342.

Rylaarsdam, K.W. 1983. Life histories and abundance of colonial corals on Jamaican reefs. Mar. Ecol. Prog. Ser. 13: 249-260

Smith, S.R. 1992. Patterns of coral recruitment and post-settlement mortality on Bermuda's reefs: comparisons to Caribbean and Pacific reefs. Amer. Zool. 32: 663-673.

Shinn, E. 1976. Coral Reef Recovery in Florida and the Persian Gulf. Environmental Conservation Department. Shell Oil Company. Houston, Texas.

UNEP. 2004. People and reefs: successes and challenges in the management of coral reef marine protected areas. UNEP Regional Seas Reports and Studies No. 176.

Vermeij, M.J.A. 2006. Early like-history dynamics of the Caribbean coral species on artificial substratum: the importance of competition, growth and variation in life history strategy. Coral Reefs. 25: 59-71.

APPENDIX A:

CHRONOLOGY & SUMMARY OF EMERGENCY RESTORATION ACTIONS

I. Introduction

Based on conditions revealed in their earliest investigative dives at the site, the Trustees determined that emergency restoration actions, as defined by 15 CFR § 990.26, were necessary to minimize continuing, and to prevent additional injury to and losses of natural resources at the site. The Trustees developed an Emergency Restoration Plan in cooperation with the Responsible Party. Some work covered by that plan (caching of coral fragments) took place in May and June 2006 but the remaining field work began in July 2006 and was complete by March 2007.

The Trustees posted a Notice of Emergency Restoration Action on November 5, 2006 at http://marineincidents.com/margara_admin_record.html pursuant to 15 C.F.R. § 990.26 to provide public notice of these emergency restoration actions. That notice summarized the basis for undertaking emergency actions, the actions planned and the status of implementation of those actions. These emergency restoration operations were initiated May 15, 2006 and completed in March of 2007.

The Trustees found mid-course corrections to be necessary after Hurricane Dean passed south of Puerto Rico in August 2007. That storm exposed additional vulnerabilities at the site, including some associated with the prior emergency restoration work. Corrective measures were initiated in November 2007 and completed in the spring of 2008. Notice of the mid-course correction (a second Emergency Restoration event) was posted October 30, 2007 at http://marineincidents.com/margara_admin_record.html. These emergency restoration operations were implemented during the fall of 2007 through the spring of 2008.

Copies of both notices are included in the Administrative Record for this Incident.

II. Summary of 2006-2007 Emergency Restoration Actions

The Trustees' earliest inspections of the site in May 2006 and subsequent reconnaissance and assessment dives revealed thousands of square meters of diverse reef habitat to be severely impacted. Impacts included destruction, crushing, breaking, dislodging or burying of many species of soft corals, sponges, and hard corals, including Staghorn coral (*Acropora cervicornis*). Fracturing of reef substrate was observed in some areas. Large numbers of dislodged, broken and buried corals were observed in addition to substantial amounts of rubble. Antifoulant paint remnants with toxic constituents covered some disturbed areas. Loose and buried reef biota were at risk of imminent loss due to further movement or burial, remobilization of rubble, potential hurricanes in the 2006 season, and a potential coral bleaching event. The Trustees determined a variety of actions were urgently needed to minimize continuing or prevent additional injury to natural resources, including biological triage (to reposition, right, and cache displaced hard and soft corals and "live rock" fragments; reattachment of cached biota and associated reef substrate to rescue as many organisms as possible; localized containment or stabilization of rubble; moving grounding-associated rubble from berms; antifoulant paint removal/disposal in impact areas and post-implementation.

The 2006 emergency restoration actions began with the caching of fragments suitable for reattachment throughout May and June 2006. The primary field work was initiated by the RP in July 2006 under Trustee oversight and was completed in March 2007. This work resulted in reattachment of almost 9,500 soft corals, hard corals, and coral fragments, including 955 *A. cervicornis* fragments, removal of

approximately 55 gallons of anti-fouling paint and contaminated substrate (Figure 1), and stabilization of some large rubble. Tagging and mapping of reattached biota relative to on-site reference markers also occurred to facilitate future monitoring.

Monitoring was initiated in the spring of 2007 to evaluate the performance of the emergency restoration, including the structural integrity of the restoration and the heath and survival of reattached corals, in accordance with a Monitoring Plan for Emergency Restoration. The Monitoring Plan includes monitoring criteria, frequency of monitoring, reporting and criteria for corrective actions.

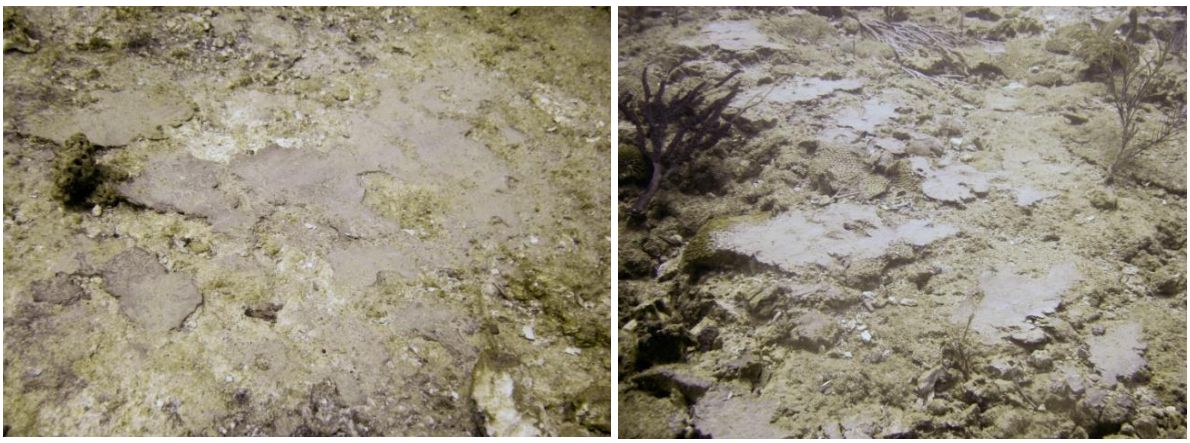

Figure 1: Anti-fouling paint from the hull of the T/V MARGARA found on the reef at the grounding site. Photos by NOAA Restoration Center, 2006.

III. Summary of Midcourse Corrections

Hurricane Dean passed to the south of Puerto Rico as a Category 5 hurricane on or about August 18, 2007. The Trustees conducted post-storm surveys of the 2006-2007 emergency restoration at the site on August 30, 2007 and again with RP representatives on September 4-6, 2007. These surveys revealed that waves and currents generated by the storm had exposed vulnerabilities in both the emergency restoration actions previously undertaken and within the overall grounding site that threatened to impede the recovery of injured coral resources and cause additional coral losses. Further, an additional 633 square meters of reef were injured, bringing the total impacted area of reef to 7,541 square meters. This additional area of injury resulted from loose rubble within the site being mobilized by storm waves and currents and by the destabilization and movement of elements that were inadequately reattached during the initial Emergency Restoration.

Conditions revealed by post-Dean surveys included:

- Large amounts of loose rubble across the site re-mobilized and swept through the site, resulting in observable injuries, including through burial, to some coral reattachments and to previously un-impacted areas of reef. Large amount of loose rubble remained, with similar opportunity for future re-mobilization and risk of causing further injuries.
- Some previously reattached corals were dislodged and needed reattachment at a more protected location.
- A large number of reattached corals suffered excessive scouring, increasing their potential for loss during the next high energy event.
- Two of four *A. cervicornis* restoration sites suffered heavy loss of reattached fragments as a result of loose rubble sweeping through these areas. Approximately 225 *A. cervicornis* fragments were salvaged and needed reattachment.

- A large *A. cervicornis* thicket impacted during the grounding appeared to have some direct storm impact. Rubble that remained on the top of this impact from the original Incident moved into the un-impacted *A. cervicornis* and buried live tissue.
- Exposure of additional hull paint that has previously been buried by rubble.
- The overall injury was larger due to the movement of rubble onto the adjacent un-impacted reef where, in most instances, it had buried most of the hard corals leaving only the soft corals intact.
- Of all the monitoring stations that had been set up earlier in 2007, 15% of those restoration features were missing, 30% had to be reattached, and the remaining 55% were still intact.

The Trustees determined, pursuant to 15 C.F.R. § 990.26(a), that mid-course corrective actions were needed for the earlier emergency restoration actions to meet their restoration objectives and to prevent additional losses at the site. The following corrective actions were determined to be feasible, likely to minimize continuing or prevent additional injury, cost-reasonable and were implemented by the RP in coordination with and under oversight of the Trustees:

- All prior coral reattachments were checked and re-secured or relocated, as needed.
- Monitoring stations that had been damaged or dislodged by the storm were reestablished (not all of the stations were found, however).
- Loose corals were reattached or moved to more secure sites for reattachment, as appropriate
- At *A. cervicornis* sites, fragments were reattached to new or existing attachment points and loose rubble was removed or secured.
- Limited, immediately necessary rubble stabilization, using cement and incorporating it into the individual installations or modules.
- Removal of additional hull paint.
- Damaged moorings were replaced.

The mid-course corrective actions were initiated in November of 2007 and completed in the spring of 2008. Additional hull paint was also subsequently exposed by the passage of Hurricane Omar in October 2008 and later removed as well, to the extent possible (Figure 2).

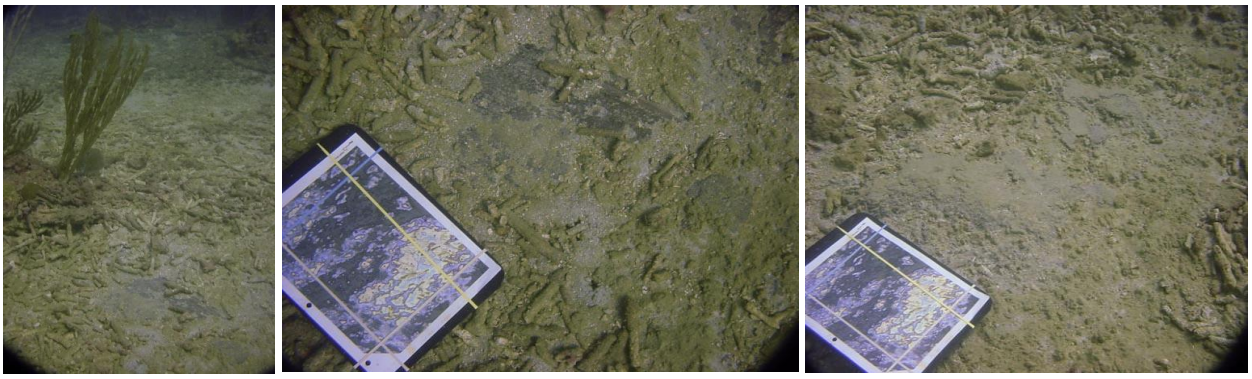

Figure 2: Anti-fouling paint at the MARGARA site exposed by Hurricane Omar, October 2008. Photos taken by NOAA Restoration Center in October, 2008.

IV. Effect of Emergency Restoration

Approximately 10,500 corals were reattached as part of the emergency restoration efforts, saving many corals that would have eventually perished through continued movement and abrasion during storms.

Figure 3 below provides a comparison between the size classes of corals found in the un-impacted reef area adjacent to the T/V MARGARA site and the size classes of the corals that were reattached during the emergency restoration. A higher percentage of scleractinians in the 10 – 20 cm size class range were reattached during the emergency restoration than were found in the adjacent reef, and a lower percentage of corals greater than 30 cm were reattached compared to the size distribution of scleractinians found in the reference area. For octocorals, a higher percentage of corals in the 20-40 cm size class were reattached. Size class distributions were similar (within 5% of each other) for the other size classes for both reference and restored areas.

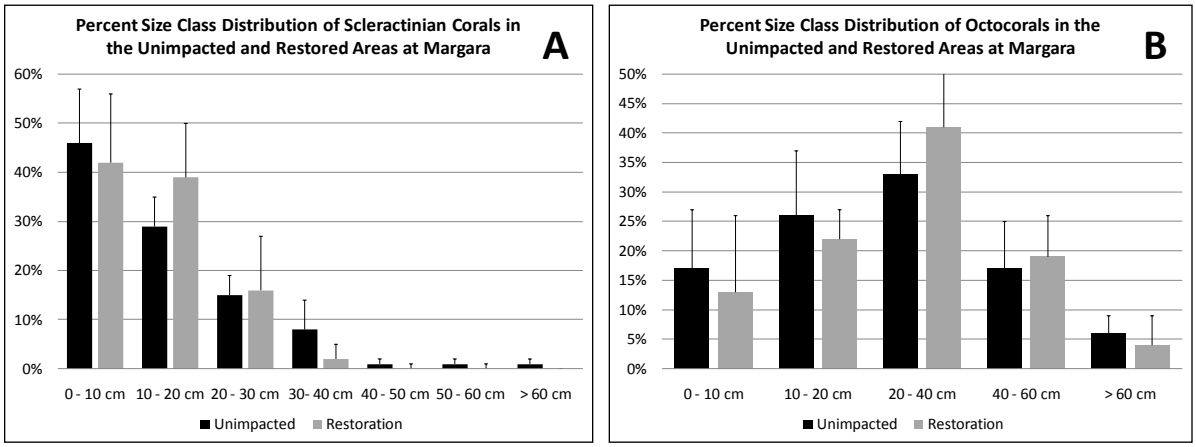

Figure 3: Percent size class distributions of scleractinians (Graph A) and octocorals (Graph B) in the un-impacted reef adjacent to the T/V MARGARA site (black bars) and in restored areas after emergency restoration (gray bars).

Emergency restoration efforts did not address the large volumes of loose rubble that remain at the site that were found to have caused additional injuries during Dean nor did the loss of topographic complexity of the reef areas that injured.